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ABSTRACT

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair. Fairs operate on a step basis. Students who win in small, local fairs, move to a city fair, then to a regional fair, and may be chosen to represent that fair in the International Science and Engineering Fair (ISEF). The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 37th ISEF in Fort Worth, Texas, in May 1986 as the result of being chosen the best in 352 affiliated fairs. Abstracts are organized by project categories. These 13 groups are described and include: behavioral and social sciences; biochemistry; botany; chemistry; computer science; earth and space sciences; engineering; environmental sciences; mathematics; medicine and health; microbiology; physics; and zoology. An index is also included of all the finalists. (ML)

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ABSTRACTS

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ABSTRACTS

37th International Science and Engineering Fair

Abstracts of the Finalists

of the

International Science and Engineering Fair

held in

Fort Worth, Texas

May 11-17, 1986

SCIENCE SERVICE
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PREFACE

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair.

The purpose of fairs is threefold: to stimulate in young people an active interest in science and engineering; to provide an educational experience through being exposed to the judges and to the public; and to give public recognition to talented students for the work they have done.

Fairs range in scope from the local level, which may involve one class, or one district, to ones which may involve a large city, a county, a state, or even a nation. While there are no exact figures, it is estimated that over one million student projects are undertaken each year in the United States, and that there are fairs in more than twenty other different countries.

Science and engineering fairs operate on a step basis, with students who have won in small fairs participating in large fairs as representatives of the fairs in which they have previously won. Thus, an individual might participate in a local fair, move to a city fair, then to a regional fair, and be chosen there to represent that fair in the International Science and Engineering Fair.

The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 37th ISEF in Fort Worth, Texas, in May 1986 as the result of being chosen the best in 352 affiliated fairs.

Science Service, the nonprofit institution devoted to the public understanding of science, which conducts the International Science and Engineering Fair, pays tribute to these finalists, to their teachers, and to the thousands of individuals and organizations who made possible the presence of these ISEF finalists in Fort Worth.

We wish to thank the General Motors Foundation for the funds which supported the printing of this book.

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BEHAVIORAL AND SOCIAL SCIENCES

+A SONAGRAPHIC ANALYSIS OF DISTINCT VOCALIZATION PATTERNS - A THREE YEAR STUDY OF ASPECTS OF COMMUNICATIONS AMONG RINGNECT PHEASANTS

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Teacher: Randall E. Raymond

Communication among humans is utilized in virtually every facet of life. Without communication the human race would struggle to survive. Without communication the Ringneck Pheasants (Phasianus torquatus) would struggle to survive as well. Their vocal interactions enable them to ward off predators, identify an individual bird or attract a mate. Based upon the results of the initial three years of research, the data has demonstrated that these birds do display a complex mode of vocal and physical communications. Various tests were conducted to examine the vocalizations elicited by male and female ringneck pheasants. Vocalizations were recorded through the use of a parabolic dish, patched to a tape recorder. The dish was placed in an anti-echo recording booth. High quality recordings were obtained using a JVC stereo cassette recorder with Dolby Noise Reduction. Specific calls were replayed to the pheasants in both group and isolation settings to determine vocal and physical responses that these sounds produced in the pheasants. An activity code system was designed to reflect increasing physical activity on a scale of 1-10. The Uniscan II, Sonagraphic Vibralyzer and a Digital Sona-Graph model 7300 were utilized to differentiate between 1,183 vocalizations recorded over this three year period*. This led to the identification of 15 distinct male and 22 distinct femals calls. Based upon this research it has been determined that the communication patterns that these birds utilize are far more complex than has ever been previously demonstrated. At the present time a complete analysis is being conducted to determine just when these birds actually begin to develop their patterns of communication. This phase of the research has discovered that pheasant chicks as young as 10 days can produce adult territorial defense calls with no prior association with adult birds. This finding has never been noted before.

*equipment generously provided by Dr. Robert Payne, University of Michigan Museum of Natural History.

+Second Award - General Motors ISEF

THE DEVELOPMENT OF A TEST TO REVEAL POTENTIAL GEOMETRY STUDENTS UNDER BESE BOARD REQUIREMENTS

**Wade, Frank P., South Terrebonne H.S., Bourg, LA 70343;
2208 Acadian Dr., Houma, LA 70363**

It was determined by a previous project that a test could be developed using optical illusions and perception of embedded figures along with an understanding of simple logistics to predict the mathematical success of a random student. The test developed covered the Math I, Math II, introductory algebra, Algebra I, Algebra II, calculus, business math, and computer science courses. The testing was later confined to Algebra I students in an effort to determine if a student had enough of an intellectual mathematical background to be recommended for the geometry course under new Board of Elementary and Secondary Education (BESE) requirements for geometry. The new requirements are such that in order to graduate, a student must have successfully completed the geometry course. According to the test administered, 66% of the students tested were not ready for the geometry course while 34% of the students were ready for the geometry course with 8% scoring an "outstanding" on the test.

#TESTIMONIES: COGNITIVE vs. STANDARD

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This research was constructed to determine the view of the death penalty and the accuracy of the eyewitness testimony. A Cognitive Interview would validate whether the eyewitness could retain a higher detail percentage of a crime over a years time, compared to the standard police interview.

Thirty-eight subjects were contacted from the sample previously tested a year ago, and split into two groups according to their personal testimony accuracy. Accuracy was based on fourteen details of a simulated crime viewed on video tape. Each of these groups were randomly split in half again. Setting the high and low, control and experimental groups. Each subject was tested, the resulting data was analyzed.

This study shows that in phase II the high cognitive group retained an average of 35.8% of details compared to 22% by the high standard. The low cognitive retained 14.25% and the low standard retained 15.88%. All groups tested fell in accuracy from phase I, but the one group of least difference is the high cognitive group. 92% of the subjects tested in phase II remembered the weapon of a gun was used. 60% remembered the suspect was a male, compared to 81% in phase I.

Therefore, this data supported the hypothesis that the cognitive interview enhanced detail recall in group 2, not in group 1.

#Honorable Mention - American Psychological Association

#BEHAVIORAL STUDY AND STRIDULATORY SOUND WAVE ANALYSES OF HIPPOCAMPUS KUDA

Crook, Angela R., Sunnyside Senior High School, Sunnyside, WA 98944; 339 N. 14th st., Sunnyside, WA 98944.

The mechanism which creates stridulatory sounds, produced by the seahorse *Hippocampus kuda* when feeding, mating, or experiencing disorientation, is not fully understood. The objective of the project was to discern whether the sounds are made by the clicking of the jawbones or by resounding on the air bladder, the only two known modes of sound production in bony fish.

In order to understand the functional morphology of the sound mechanism a subject was dissected and its systems were sketched. Live subjects were tested while feeding and their sound wave patterns were recorded with a crystal microphone, an oscilliscope, a video camera, and an amplifier. Wavelength and amplitude analyses were conducted and reported. Several sizes and types of food were given to detect changes in wave patterns. Differences in wave patterns occurred in direct variation with differences in size of subject tested, size of food, and state of food. Smaller subjects produced smaller wavelength and amplitude readings; larger food size caused greater wave measurements; and feeding live prey produced greater sound waves than did feeding frozen food.

The evidence gained through experimentation supports the theory that the stridulatory sounds are created by jawbones clicking together. It is possible that the air bladder plays a role in amplifying the sounds made by the jaws.

#Second Award - General Motors ISEF

#MARIJUANA - DOES IT AFFECT MEMORY?

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I wanted to test the affect of marijuana on memory. I built a three story maze and obtained six pinto rats which I trained to complete the maze in as little time as possible. I labled the rats C1 and C2 for the control, S1 and S2 for short term exposure to marijuana, and L1 and L2 for long term exposure. Then for fourteen days I timed how long it took the rats to complete the maze.

I then began exposing the rats to marijuana. I exposed rats S1 and S2 to five minutes of marijuana for fourteen days. Immediately after exposure I ran the rats through the maze and timed how long it took them to complete it. Then for twenty-eight days I stopped exposing the rats to marijuana, but ran them through the maze and timed them.

I then exposed rats L1 and L2 to twenty-eight days of marijuana smoke, each day immediately after exposure I ran the rats through the maze and timed how long it took them to complete it. Then for fourteen days I stopped exposure and ran them through the maze and timed them.

Each day of the fifty-six days of the experiment I ran the control group through the maze and timed them to use as a basis for the times of the rats who were being exposed to marijuana.

Rats C1 and C2 took an average time of 24 seconds to complete the maze.

Rats S1 and S2 took an average time of 25 seconds before exposure to smoke, two minutes and three seconds during the exposure, and 52 seconds after the exposure to marijuana.

Rats L1 and L2 took an average time of 24 seconds before exposure to smoke, two minutes and thirteen seconds during the exposure, and one minute and five seconds after exposure to the marijuana.

#Third Award - General Motors ISEF

# ETHOLOGICAL STUDY OF ULOBORUS GENICULATUS WITH EMPHASIS ON CHANGES OF PATTERNS IN A WEB CONSTRUCTION

Vega Martínez, Leopoldo - Felipe Colón Díaz Junior High School
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The investigation is based on the changes of patterns in a web construction from the specimen Uloborus geniculatus when submitted to centrifugal force. Through this study drastic changes are observed in the pattern from an orbicular to a complete irregular pattern. The study included the changes in the specimen's irritability it to different revolutions in centrifugal force. The answers or feedbacks from physical stimuli such as, light, color, electricity and also chemical stimuli. When the specimen is returned to its natural habitat, drastic noticed in its feeding habits. Generally the controlled specimen will feed itself from the Musca, sp. while the experimental specimen feed itself from Drosophila, sp. Changes were noted on the quantity of victims captured in the web, since the viscous chemicals that the spider uses on its web to capture its prey changes in chemical consistency. The aggressiveness of the specimen submitted to centrifugal force and later returned to its natural ecological habitat undoubtly affected. When the strange specimen enters the web, the experimental spider attacks. In the same manner if placed in the web of another specimen, it will attack and finish it off.

#Fourth Award - General Motors ISEF

SOCIALISM IN THE U.S.: YESTERDAY'S, TODAY'S, AND TOMORROW'S TRENDS

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Socialsim is a political philosophy that has swept through the Western world during this century leaving its path of destruction wherever it hit. Although commonly not referred to as socialism, the trend of ideals from the left of the political spectrum has progressively increased in the US, esp. since the New Deal and the Great Society programs. The baby-boomer and hippie generation has largely been perceived as the most socialistic group in our society while there is talk of a political realignment in today's youth. Since the inauguration of a very popular President, the youth has identified itself more and more with the political right and often the Republican Party. There is, however, large disagreement among political analysts and experts whether this is a temporary trend brought about by the vibrant personality of President Reagan, or whether it represents a dramatic and permanent reversal of attitudes and philosophies.

In order to predict future trends adequately, the attitudes of today's young leaders have to be compared to the philosophies of the preceding generation. A permanent political change can only happen if it is led by a deep philosophical change. Have today's young minds been shaped in the image of our immediate ancestors as sociological studies indicate it should be, or are these minds going to cause a historic realignment? Have socialistic ideals been so deeply indoctrinated into today's youth as to make change impossible?

This study attempts to answer these questions in order to predict future events. It also attempts to emphasize the effects of socialism thus far and to provide a solid alternative to the failing political and economic system of collectivism -the American system of capitalism.

EFFECT OF MUSIC THERAPY ON DEPRESSED INSTITUTIONALIZED ELDERS

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This study is a quasi-experimental research which attempts to investigate the effect of music on depressed institutionalized elders.

It was expected that there would be significantly valuable differences in the depressive state of the group submitted to the music therapy and the not-submitted control group.

A review of the literature revealed the beneficial effect of music for the person 65 years or over. In this group, Goldberg and Fitzpatrick (1980) found changes in relation to self-esteem and morale in residents of an institution who were given exercise therapy.

Other authorities (Burnside,1980) (Blazer, 1982) stated that music is a very important factor in the daily activity and it helps to better understand the dynamics of depression.

An experimental group of five depressed elders participated in four music therapy sessions. The control group consisted of five elders with symptoms of depression to whom no music therapy sessions were given.

#COMPUTER REHABILITATION OF STROKE AND ACCIDENT VICTIMS SUFFERING VISUOSPATIAL AGNOSIA

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In determining if there would be a significant difference between the Visuospatial rehabilitation of stroke and accident victims; an original computerized therapy program was compared to existing traditional therapy. The subjects' rehabilitation was measured by administering a pre and post test for each of the therapy modes. Six Metro-East hospital Occupational Therapy Units in Illinois and Missouri were contacted requesting their cooperation. Three hospitals agreed to assist. Subject selection was limited specifically to patients having lost their visuospatial abilities by damage to the right hemisphere of the Parietal Lobe. Subject identification was through Medical CAT scan and normed functional testing. Seven stroke and two brain-injured subjects fit the experimental criteria and agreed to participate. Workshops were held by me at each hospital to acquaint and instruct the OT Unit staff on the experimental procedures. Each subject completed a set number of trials in each therapy mode and data was charted during each trial by the OT Unit staff. Subject confidentiality and safety was guaranteed at all times. The seven stroke subjects were selected for the statistical analysis. A t-test for Correlated Samples Using Matched Pairs and Sandler's A Statistic were used to analyze the data. Results indicated a significantly better post test score, ($p = < .0005$) for the computer therapy mode. Based on two years of prior research which established computer competency (therapy) as a reliable 'tool' for increasing visuospatial abilities; and this year's tightly controlled research results, it can be concluded that computer therapy is a valuable therapeutic addition to traditional therapy modes. Future applications include testing Autistic, Dyslexic and L.D. children.

#First Award - American Optometric Association and Auxiliary to the
American Optometric Association
Third Award - General Motors ISEF

#THE USE OF DOVETAIL PRISMS IN THE STUDY OF HUMAN ADAPTATION TO AN INVERTED ENVIRONMENT

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704 Melba Denton Ln., Sallisaw, OK 74955

The human brain is a powerful organ that may have the ability to adapt to many conditions. The purpose of this research is to describe the experience of the process of adaptation to an inverted environment.

The first step of the project was to purchase the prisms which were needed for the inversion. After the prisms were in position in front of the subject's eyes and the environment had been inverted, the observation began. The time of inversion was a time of depression and frustration because everything was opposite to what it should have been. The major problems were tasks which involved hand and eye coordination. The subject's hands seemed to work antagonistic to each other. By the end of the second day, the subject was able to get around the house and do hand and eye tasks rather easily, even though the images were clearly inverted. Frustration was always predominent because of tunnel vision; he constantly tripped over objects, not because they appeared inverted, but simply because they could not be seen.

On the third day the subject could get around and do things very easily. In the afternoon of the third day after a long nap, when he awakened, the images appeared to be normal. When the subject removed the glasses, the images seen were once more inverted. By late morning of the next day the images were again normal.

#First Award - Americal Medical Association

ARE YOU LISTENING?

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The objective of this research, which was a continuation of a study begun November, 1984, was to determine if different types of music affect one's ability to retain and later recall factual information from a story. It was hypothesized that people listening to classical music would have a higher recall rate and better test percentage than groups tested with other types of music, even higher than the control group (no music). In this study, groups of children in the fourth, fifth, and sixth grades were given a story which they were asked to read. While reading the story the test subjects were exposed to one type of music being played at 75 decibels. Classical, country western, easy listening, or popular music were the types of music used; or in the case of the control group no music was played. Then, the music continuing, the stories were collected, and a question sheet was distributed. The overall results indicate that it was best to listen to classical music while reading and studying. Also classical music proved to be a better study aid than the control group. The conclusion stated that, based on this research, classical music was better than no music at all in studying and testing situations.

THE EFFECTS OF SOUND WAVES ON CRICKET BEHAVIOR

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Crickets hear in the ultrasonic range. The male crickets attract their mates by producing sounds by rubbing their legs. Fifty (50) house crickets (Acheta domesticus) were placed in small gerbil cages ("Habitrail" type) and exposed to ultrasonic waves at different frequencies. The ultrasonic waves were produced by an Audio Frequency Generator. The frequencies were measured by a Digital Frequency Counter. The ultrasonic waves made the experimental group less active than the control group.

THE EFFECTS OF B VITAMINS ON CASES OF DEPRESSION

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From this experiment, I wished to find out if B vitamins effect depression favorably, by reducing or alleviating it. The hypothesis was that the B vitamins would show improvement, Dimethylglycine slightly more than Thiamine. To do this, 72 students were pre-inventoried, ages thirteen to eighteen. From these scores how many showed signs of depression was determined. These students and an equal number of students not showing signs of depression were asked to take a 21 day supply of Dimethylglycine or Thiamine. Twelve agreed to participate, returned their permission slips, and after taking the three week vitamin supply given to them, were re-inventoried. From these scores, the definite improvement of those experimented on has been detected. Those given Dimethylglycine improved by 80.0%, and a 74.5% improvement was shown in those taking Thimine. Statistically, the experimental group improved over one Standard Deviation, indicating significant results. I believe these results support treating depression, a very serious problem among teenagers, with B vitamins. The importance of this experiment is shown by the fact that there are over 10,000 "successful" teen suicides yearly, and the number one reason is depression. The application is saving lives.

DETERMINING WHY STUDENTS ARE ON FAILING LISTS

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P.O. Box 238, Mason, TX 76856.

Factors are trying to be determined why students are on the failing list.This was achieved by the distributed questionaires.Their data gave some evidence as to 'why students are failing'.

Some reasons were:

1. Failing students do not devote as much study time as most honor roll students.
2. Failing students do not compete with their peers unlike honor students.
3. Failing students do not find school interesting and fun.This is because of a feeling of failure.
4. Parents did not read to their child at a younger age which affects his attitude toward learning.
5. Failing students have a low self-esteem.
6. More time is spent partying and away from the home by the underachiever rather than the honor student.
7. Failing students do not relate school to future life situations.

These reasons could help underachieving students become dependent. Most underachievers are afraid of failing, therefore they never try. The constant image of failure can give a student a poor self-image and esteem.

Counciling can cause a breakage in the cycle of the underachiever, the failing student.

LEFTHANDERS VS RIGHTHANDERS

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The purpose of this project is to see if there is a difference between right and lefthanded individuals concerning memorization and reaction speed. The procedure includes writing a program that will test individuals on memorization and reaction speed and then testing as many individuals as possible. The average scores on the tests will be taken and then compared between lefthanders and righthanders. The conclusion is that lefthanders scored higher on memorization while righthanders scored higher on reaction speed.

STROBE LIGHTS: DO THEY AFFECT YOU?

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RR. 1 Box 58 Warner, SD 57479

This project was done to find out more about whether or not strobe lights affect a person. It was continued from what was started last year. The research this year was to find out how strobe lights affect younger students. The tests used were the throwing of tennis balls into a five gallon bucket, the solving of math problems, and the measuring of a volunteer's reaction time. Each test was taken in a room with florescent light and then in a room with only strobe light. The results for the math quiz were that the strobe light seemed to hinder all grades that were tested, 1st, 2nd, 7th, and 8th. But it seemed to affect the 1st grade boys and girls group the most. The results for the ball throwing were that the 1st grade boys and girls group and the 1st and 2nd grade girls group seemed to have done worse with the strobe light than with regular light. The 2nd grade boys and girls group, on the other hand, did better in strobe light than in regular light. For the reaction-time, only the 1st grade boys and girls group did worse in strobe light and all the rest did better. This could indicate that strobe lights affect younger people more than older people. The summary of all the results indicates strobe lights may have a greater effect on the problem solving ability of people compared to the eye-hand coordination ability.

#A STUDY OF THE EFFECTS OF SELECTED CARBOHYDRATES ON ALCOHOL ABSORPTION AND BEHAVIORAL MODIFICATION IN HUMANS

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This study investigated the influence of selected carbohydrates on alcohol absorption rates to determine if there was a significant reduction in blood alcohol levels.

Seventy subjects were tested in a double blind experiment. They performed 438 skill tests consisting of a computer test, sequence test, dartboard test, and straight line test. One hundred and forty blood samples were drawn and tested for blood alcohol determination, glucose level evaluation, and SMAC profile. The blood alcohol levels were performed by this researcher on the Sigma 3B Capillary Chromatograph. Glucose levels were measured using Sigma 510-DA serum glucose test kits and the Bausch & Lomb Spectronic 20. Blood test data and skill test data was analyzed using the t-test.

It was determined that glucose and fructose showed a significant effect on alcohol absorption and motor performance. Women performed significantly better than the men on the dartboard post-test. This could be related to the sugar they digested. In the test vs. test group, there were significant differences in glucose vs. fructose in dart test at the .005 level and the glucose vs. saccharin at the .0001 level. In the st. line test pre-test, fructose vs. glucose had a significant difference at the .0001 level and the glucose vs. saccharin post-test at the ,03 level. The glucose and fructose groups' alcohol levels were measurable lower than the saccharin group. The sucrose group's alcohol levels were measurably higher than the saccharin group.

These results support the possibility that carbohydrates serve as blocking agents capable of modifying the absorption of alcohol by certain nerve centers.

#First Award - American Medical Association
First Award - American Psychological Association
First Award - United States Air Force
First Award - United States Army
Third Award - General Motors ISEF

#THE RELATIVE IMPORTANCE OF CHEMICAL AND BEHAVIORAL INHIBITION IN RANA CATESBIEANA

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Metamorphosis of tadpoles is the transition period between early larval stages adapted to aquatic environment and adult stages adapted to diverse terrestrial habitats. Metamorphic parameters of growth and differentiation vary as affected by chemical or behavioral inhibition. This investigation explored the types of inhibition and degrees to which they affect growth and differentiation rate of the frog species, Rana catesbieana.

In the first experiment, it was hypothesized that relative access to the food source would affect the rate of growth and differentiation of tadpoles whose food sources were either concentrated on one side or on both sides of a partition. In the second experiment, it was hypothesized that behavioral and chemical inhibition would be elicited relative to varied tadpole population densities and food levels.

In the first experiment, inhibition occurs to a greater degree between tadpoles in bowls where access to food is impeded by a partition. Behavioral inhibition delayed the differentiation of the largest tadpole in bowls where food was concentrated on one side of the partition. In the second experiment, varied food density demonstrated the effects of chemical inhibition. In greater densities, growth rate is accelerated and differentiation is inhibited. In lesser densities, differentiation is accelerated and growth is inhibited.

#Honorable Mention - American Psychological Association

#DOES ELECTROMYOGRAPHIC FEEDBACK/PROGRESSIVE MUSCLE RELAXATION TRAINING IMPROVE ATHLETIC PERFORMANCE?

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To assess the merits of electromyographic feedback (EMG) and progressive muscle relaxation training on athletic performance, I studied the effect of these two techniques on basketball players. I predicted that training the athletes in these techniques would enhance their freethrow shooting.

I selected five athletes as my experimental group. Five other athletes of comparable shooting ability at the beginning of the experiment served as the control group. The EMG portion of the experiment consisted of eight feedback sessions, lasting fifteen minutes per athlete per session. To acquire progressive muscle relaxation abilities, each athlete listened to a thirty minute training tape every other day.

The results proved my hypothesis correct. The freethrow percentages of the experimental group increased from 68% to 75%, a 7% difference. The control gorup increased from 68% to 69%, a 1% difference. These percentages show greatly the athletic improvement due to the use of electromyographic feedback and progressive muscle relaxation training. This high technology can improve all areas of athletics and give teams a winning edge.

Our society places great emphasis on athletic performance. My project demonstrates that EMG and progressive muscle relaxation training provide simple, yet effective methods for improving fine motor control and athletic performance. These techniques can remedy less than optimal performance by athletes in a variety of sports. In fact, these methods should be applicable to any endeavor requiring manual dexterity and concentration.

#Third Award - General Motors ISEF

# AN ANALYSIS OF THE FOOD GATHERING HABITS OF THE TROGLOBITIC BLIND CAVE CHARACIN, ASTYANAX FASCIATUS MEXICANUS

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The purpose of this project is to discover how blind cave characins, Astyanax fasciatus mexicanus, who live in the troglobitic Mexican cave of La Cueva Chica, are able to locate their food. Research provided no answers. I first tested them for light sensitivity. The control fish, Hasemania nana, showed much reaction to light. The blind cave characin showed no reaction proving that they are totally blind. I next tested the sensitivity of their olfactory receptors and gustatory chemoreceptors. I designed and built a special test tank so that I could control the introduction of a food solution into the tank. A few seconds after the solution was introduced into the tank, the blind characins always reacted violently. The control fish, on the other hand, showed no reaction proving that blind cave characins use their acute senses of smell and taste to find food. I have also tested them to determine if vibrations, heat, and currents play a role in helping them find food and have found that they do not. After performing these tests and reviewing the results, I have come to the conclusion that blind cave characins are able to locate their food through the use of their smell and taste senses and through random searchings.

#First Award - General Motors ISEF
Honorable Mention - American Psychological Association

SUGGESTION: A STUDY OF THE EFFECTS OF SUBLIMINAL STIMULI ON THE ACADEMIC AND ATHLETIC PERFORMANCE OF HIGH SCHOOL STUDENTS

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Overview

Subliminal perception, a controversial area of study, is the basic for this project. Suggestive messages were used to determine if tachistoscopically administered slides could change the academic and athletic behavior of high school students. This project is composed of two experiments--one studying academic performance and the other athletic skill performance. Each study was conducted and analyzed separately.

Experiment #1

Ninety Biology I students in five classes were used for this experiment. Each class was divided into three groups of equal grade averages. Twenty slides were prepared for each group. The slides contained the following messages: I WANT TO GET HIGH GRADES, THIS IS AN EASY CLASS, and PEOPLE ARE STANDING. Students were exposed to the slides for twenty days.

Experiment #2

For this 20-day experiment, 109 students in three Physical Education classes were used. Each class was divided into three groups after all students had shot ten free throws. Each group had approximately the same shooting average. I WANT TO MAKE THE BASKET, I WILL MAKE THE BASKET, and PEOPLE ARE STANDING were the messages exposed to the students.

Conclusions

The results, which were based on continued grade averages and shooting averages, were analyzed by F tests. Though trends were noticed, no statistical evidence showed that suggestive subliminal messages can change academic or athletic performance in high school students.

# ALCOHOLISM- INHERITED OR ENVIRONMENTAL

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Alcoholism continues to be a major social and medical problem in our society. Can a tendency toward alcoholism be inherited?

The purpose of this research was:

1. To identify a breeding pair of white mice who showed a preference for ethanol.
2. To follow their offspring for several generations noting those mice with a preference for ethanol.
3. To compare behavioral and physical observations of the two test groups.

Mice were permitted free choice of water and water with ethanol. Mice with a clear preference for ethanol were separated from those who showed a clear preference for water. They were allowed to breed. Behavioral and physical changes were observed for a period of one year.

It was concluded that more offspring of the ethanol-prefering mice chose the ethanol-water mixture than did the water drinking mice. The "alcoholic" mice also had a greater tendency toward abberant behavior and birth defects. This research provided some evidence for the possible transmission of an ethanol-preference tendency to offspring in mice.

#Fourth Award - General Motors ISEF

HOW DOES MODIFICATION OF CIRCADIAN RHYTHMS AFFECT THE BEHAVIOR OF TREE AND CHORUS FROGS?

Bliesner, Terry A., Sunnyside Junior High School, Sunnyside, WA 98944; Route 2, Box 2262, Sunnyside, WA 98944.

OBJECTIVE: The objective is to determine how different Photoperiods affect the activity of Tree and Chorus Frogs. The Frogs' activity will be measured at different times with the use of a Kymograph. An analysis of Wavelength, Amplitude, and Frequency of their activity will be made.

METHODS: Place the Frogs in a Experimental Photoperiod. The Photoperiod must be maintained. After the Frogs have been in the Experimental Photoperiod for one week, the Frogs will be tested at seven different times. The Frogs will be chosen at random for testing. The Frog is placed in the Kymograph. The Kymograph is turned on for fifteen seconds. The paper is labeled, the kind of Frog tested, the Photoperiod, time tested, and if flies are used, write the number of flies left. After the second week of testing. The Frogs are taken out of the Photoperiod. They are placed in the Recovery for the Photoperiod. After this week of testing the Frogs start a different Photoperiod. A wave analysis will be made. The waves will be analyzed for the number of Waves, Frequency, Amplitude, and Wavelength.

RESULTS & CONCLUSION: The Tree and Chorus Frog's activity was the same or greater than the control after being in the Experimental Photoperiods for two weeks. The Tree and Chorus Frog's activity was less than the control in all of the Experimental Recoveries. There was no significant changes in the activity of the Tree and Chorus Frogs with Flies.

CETACEAN CHRONO-CALCULATION

Tota, Frank Peter, Jr., Patrick Henry High School, Roanoke, VA 24015
430 Bramble Lane, Roanoke, VA 24014

My project was intended not only to determine diurnal and annual behavioral patterns for the Humpback Whales, *Megaptera novaeangliae*, of the Stellwagon Bank-Bermuda migration route, but to edify the public with matters concerning this rare marine species as well.

Cetacean research, the study of whales, is an infant science that leaves many questions unanswered. I worked along with three students, Kris and Elliot Tocci, and several leading cetacean researchers to observe and study the whales of Cape Cod. I spent three weeks aboard a sailboat observing the whales in their various behaviors.

In the autumn of 1984, I began research on other sightings of the Humpbacks. My research yielded hundreds of sightings. From these, I developed a diurnal behavioral pattern that seems accurate and scientifically feasible. Since then, I have expanded my research to encompass more daily sightings as well as researching an annual cycle and applying statistical analysis to all my data.

My data concluded that there seems to be a discernable pattern for daily behavior in the Humpbacks. The results were fairly consistent; the Humpbacks logged from 11 a.m. to 2 a.m., swam from 12 p.m. to 3 p.m., breached fed and fluked between 3 p.m. and 7 p.m., flipper waved and tailflopped from 4 p.m. to 7 p.m., and spyhopped between 1 p.m. and 4 p.m. Further analysis of the data is incorporated into the research paper accompanying the project.

#LEARNING IN THE SQUID, *LOLLIGUNCULA BREVIS*

Long, Traci M., Ball high School, Galveston, TX. 77550
108-B Fort Crockett, Galveston, TX. 77550

PURPOSE - The purpose of this research was to explore, for the first time, several forms of learning in one of the smarter and faster-moving cephalopod molluscs, the squid *Lolliguncula brevis*.
BACKGROUND - Squids are able to change skin color by means of chromatophores (neuromuscular pigment-containing organs) that expand to form different patterns in response to different natural stimuli. Behaviors such as the ring-type chromatophore pattern and jet propulsive escape movements were used to study simple forms of nonassociative learning (habituation, and dishabituation) in *L. brevis*. Habituation is a gradual decrease in response when an initially novel, but innocuous, stimulus is presented repeatedly.
PROCEDURE - Each animal was briefly exposed to a model of a predator to determine how the behavioral responses changed with repeated trials. Behavioral responses were video-monitored for subsequent measurements of the number of jets and the duration of ring-type chromatophore responses on each trial.
RESULTS - The squids readily habituated to a predator model and could differentiate between two different predators. Recovery of responses occurred after a lengthy interval, but the squid's responses were decreased upon the second set of presentations.
CONCLUSION - It is essential for animals to habituate to irrelevant stimuli in their environment in order to attend to relevant issues that are necessary for the survival of their species such as, reproduction and food hunting. Subsequently, this research may be valued by local neuroscientists in their study of the cellular mechanisms of learning.

#First Award - American Veterinary Medical Association
First Award - United States Navy/Office of Naval Research
Third Award - American Psychological Association
Third Award - General Motors ISEF

#EFFECTS OF LINGUISTIC BACKGROUND ON DESCRIPTIONS OF COLOR APPEARANCE

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1816 E. 17th Street, Brooklyn, NY 11229.

Color is very important in human vision. In order for us to show how people see color, a technique for specifying color appearance is necessary. One method, hue scaling, is based on hue words. However, some people believe that the language used will affect how words are used to describe color. I believe that color is a special case which can be *exactly* translated from one language into another. In my project, I plan to test this theory by using monolingual and bilingual subjects.

Both of the monolingual and bilingual subjects had normal color vision according to two screening tests. None of them had the common forms of genetic color-blindness. For both groups of subjects, I used two kinds of scaling procedures. One of the methods I call "4 + 1" category and the other I call "5" category. In the first method, subjects scaled hue and saturation sensations separately. In the second method, hue and saturation were scaled together. In both hue scales, subjects were allowed to use only the words red, yellow, green, and blue. The subjects rated their sensations, using both categories randomly, one for each day. For both categories, wavelengths ranged from 450 nm - 650 nm, in 10 nm steps. They were also presented in a random order.

The results obtained in the experiment were very similar for both the language groups. Although they were not exactly the same, the differences were not significant. As we can see, language background has no effect on how people understand and use the basic color terms.

#Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

THE EFFECTS OF PRENATAL ULTRASONIC EXPOSURE ON THE BEHAVIOR, GROWTH AND DEVELOPMENT OF THE NEONATE

Clark, Jennifer M., Bay H.S., Panama City, FL 32401
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In view of the widespread use of ultrasound in medicine, industry, and the military, the purpose of this research is to determine the possibility that prenatal ultrasound exposure causes behavioral abnormalities in the offspring from exposed parents. Earlier phases of this research have established the effects of ultrasound on plants, developing embryos of *Oryzias latipes*, and the sperm production, mortality, and abnormalities in insonated male *Rana Pipens*. During this research, a literature search revealed that studies into the behavioral abnormalities of offspring from insonated mothers were limited.

The present phase of this research studies the behavioral responses and development of juvenile *Mus Musculus* born to insonated mothers. It also studies the responses of juvenile *Mus Musculus* born to mothers that were bred to insonated males. The responses and developmental observations were charted, graphed, and relationships were established.

In conclusion, it is important to note that there were behavioral and developmental differences between the offspring from insonated parents and those from parents not exposed to ultrasound. The results of these experiments indicate that additional research should be conducted on the learning and behavior of children born to insonated mothers. If those results correspond to the results of this experimentation, then perhaps an evaluation of the necessity of ultrasound exposure during pregnancy should be established.

#Second Award - United States Air Force
Fourth Award - General Motors ISEF

Teenage Stress

#Quinlan, Kimberly Lea., Santa Catalina School, Monterey,Ca. 93940
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A study was done on teenage stress using questionaires to survey nine schools (4 private and 5 public) on the Monterey Peninsula of California. Data are based on 378 responses. School is the leading source of stress, while teachers and parents, in that order, are the principle people who cause stress in teenagers. Students in private schools felt twice as stressed by teachers and males were more stressed by teachers than were females. Males also felt twice as much stress in their homelives. Females were more concerned with their social nexus. When asked about universal problems, teenagers in this study were very worried about murder and nuclear destruction. Public schools were four times more concerned with world issues than were students at private institutions. Females were more than twice as concerned with nuclear war and poverty. Most teenagers surveyed said they became depressed and irritable when experiencing stress. Almost 10% responded that they had attempted suicide. To relieve stress private school students were more apt to turn to eating while public school students relied on television and/or radios. Three times as many public school students answered that they turned to alcohol. Alcohol and drugs were not viewed as major causes of stress. In an overall ranking tests and family situations were the leading causative factors of stress in teenagers surveyed. Males in this study experienced stress as much as females and in certain regards, experienced even more than females. This study was found to correlate well with a recent similar ABC News survey of teenagers throughout the United States.

#Alternate to Scholarship - Ohio State University

*The Effect Of The Sustance Extracted From The Fungus Basidiomicete "Paneolus Sphinctrinus" On The Hamster "Mesocricetus Auratus"

Santos,Gil A.,Luz A. Calderón H.S.,Carolina P.R. 00630
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One of the great problems of our times is the high consumption of drugs by our youth. They seem to be trying reach new experiences, to alienate themselves from the real world by living in fantasy, and trying to fill an empty void by having certain "pleasures".

Once they have experienced such "pleasures", it is difficult to live without them, thus they try to find substitutes for drugs when they find themselves without money to buy them. Needless to say, these substitutes can be more dangerous than the drugs themselves.

Through this research we presents an analysis of one of these substitutes. It is the fungus that grows on cow's excrement, scientifically known as basidiomicete "Paneolus Sphinctrinus".

This fungus has an effect on the behavior of the Mesocricetus Auratus.

The research has been elaborated in these phase,

In the first phase we conducted the labyrinth test, the noise, and wheel test in order to determine a behavioral patern.

INthe second phase we used the distance test, the labyrinth test, the noise test, and the wheel test also made a chromatography of the components.

The third phase was done in order to determine how the diferent dosages of the supernatant affected the behavior of the mesocricetus Auratus. For this we again used the labyrinth test, the wheel test, and noise test and a chromatography.

*Fourth Award - General Motors ISEF

A CORRELATIONAL STUDY OF DRUGS AND ALCOHOL, ATTITUDES, AND OTHER FACTORS RELATED TO GPA SCORES

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The purpose of this investigation was to study the relationship between students' grade point averages (GPA) and the following factors: 1) student's use of drugs and/or alcohol, 2) student's attitude toward school, 3) student's perception of parental attitude toward their education, 4) parent's socio-economic status, 5) student's report of parent's educational attainment.

Data was obtained through the use of a written survey. 233 surveys were sent out to the juniors and seniors of four high schools. The students answered questions relating to the five factors listed above. The main wage earner of the household was indicated and used as the basis of the socio-economic status determined from the Socioeconomic Index developed by Otis Duncan. Pearson Product-Moment Correlation Coefficients were computed for all possible relationships of the variables for the group as a whole.

A negative correlation, significant at the 1% level of confidence, was found between GPA and drug/alcohol use. A positive correlation, significant at the 1% level of confidence, was found between GPA and the student's perception of parental attitude toward education. A positive correlation, significant at the 5% level of conficence, was found between GPA and student's attitude toward school. Positive correlations were found between GPA and socioeconomic status and between GPA and parental education, but these were not high enough to be significant at the 5% level of confidence.

SPATIAL PERCEPTION IN DEVELOPMENTALLY DELAYED AND NORMALLY DEVELOPED

Call, Kimberly D., Cole R-V H.S., Eugene, MO 65032
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Sensory-motor refers to a combination of the input of sensations and output of motor activity. The process of organizing the raw data obtained through the senses and interpreting its meaning is called perception. This project deals with spatial perception, which is the ability to visualize objects in space.

The control group consisted of ten normally developed preschoolers (ages 3-4). The experimental group consisted of ten developmentally delayed preschoolers (ages 3-4). Using different toys that had to do with motor skills, the task completion time was measured. Then the results of both the control and experimental groups were compared.

The trials with the puzzle and shape game supported the hypothesis, that the normally developed children will be able to complete tasks more quickly than the test group because their ability to integrate is more developed than the developmentally delayed. The task completion time with the ring game and building blocks showed that on an average, the developmentally delayed were actually faster than the normally developed.

The conclusion: Based on this study, the developmentally delayed preschoolers work more slowly than the normally developed preschoolers on motor skills dealing with different shapes, but they are faster than the normally developed preschoolers working on motor skills dealing with shapes that are the same or shapes that vary only in size.

#INTRASPECIFIC AND INTERSPECIFIC INTERACTIONS AMONG SEVEN SPECIES OF TROPICAL DUCKS AT THE MINNESOTA ZOOLOGICAL GARDEN

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ABSTRACT. At the Minnesota Zoological Garden, behavioral interactions of seven tropical waterfowl species (baikal teal, falcated teal, garganey teal, mandarin duck, red-crested pochard, wandering whistling duck and white-eyed pochard) were observed over a six-week summer period. The five recorded behavioral categories were agonistic, comfort, ingestive, investigative and sexual. The focal observational method was used to accumulate 42 hours of data, with each species observed for a total of 360 minutes. The most intraspecifically active species was the mandarin duck, while the least was the garganey teal. This may be attributed to population differentials and social grouping within the exhibit. The most interspecifically active species was the falcated teal and the least was the white-eyed pochard. Interspecific responses were observed more frequently than intraspecific responses, possibly due to the enclosure's large bird population. The most agonistically inclined species was the falcated teal and the least agonistic species was the garganey teal. The most sexually active species was the red-crested pochard and the least was the white-eyed pochard. The frequency of agonistic and sexual interactions was probably reduced by three factors --- season, weather conditions, and population density. The most dominant species was the falcated teal followed closely by the red-crested pochard and wandering whistling duck. These three species seemed to have formed a social alliance. The white-eyed pochard and mandarin duck were next in dominance and were less stressed in the exhibit. The baikal teal and garganey teal were the most submissive species, relatively uninvolved in agonistic interactions.

#First Award - Eastman Kodak Company

Second Award - General Motors ISEF
Honorable Mention - American Psychological Association

*THE EFFECT OF EXTRACTS OF *PANAEOLUS SPHINCTRINUS* IN THE BEHAVIOR OF THE HAMSTER *MESOCRICETUS AURATUS* AND THE MOUSE *MUS MUSCULUS*.

Pérez, Eileen, Lola R. de Tió High School, San Germán, P.R.00753;
Urb. Porta Coeli, B-8, San Germán, P.R. 00753.

One of the sacred hallucinogenic mushrooms employed in divination and othe magic ceremonies by the chinantec and mazatec indians of Mexico is a member of the small genus *Panaeolus*. It is known as pasture mushroom or intoxicating mushroom. *Panaeolus sphinctrinus* is a delicate yellowish brown mushroom up to four inches in height whose status among the hallucinogenic mushrooms is in doubt.

This study represents an attempt to study the effect of extracts of the fungus *Panaeolus sphinctrinus* on the behavior of the hamster, *Mesocricetus auratus* and the mouse *Mus musculus*.

Three experimental groups were set up all consisting of two hamsters as controls and 2 of each sex as the experimental ones. Group A was given extract at a concentration of 10% while B had 5% and C had a 1% concentration. The extract was administered after a period of acclimation of thirty consecutive days. Food and water consumed by all organisms was carefully recorded and daily weights were also recorded.

Effect was measured by direct observation of behavior. A color preference test was used to determine effect of extract on behavior. This was supplemented by a balance test and a running wheel test. Behavior of experimental animals was altered by the extract of the fungus. Experimental organisms drank more water than the controls.

Histological sections were made of kidney, brain, testicles, lungs, intestines, heart and liver. Only brain and testicles showed some damage. All tests were repeated using *Mus musculus*.

#Fourth Award - General Motors ISEF

THE GRAVITATIONAL AND METEOROLOGICAL AFFECT ON HUMAN BEHAVIOR

Goldsberry, Bart, Box Elder High, Brigham City, Utah 84302
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To determine the cause of crimes committed, materials were obtained and information was graphically charted to show their relationship.

Crime figures from the Federal Bureau of Investigation and weather statistics from the National Weather Service were obtained. Studying crimes committed and months in which they were committed shows the basic relationship of weather and crime. A voluntary survey was sent to the Utah State Prison and results prove further the previous study.

I believed I would find a definite link between the natural affects on man and the changes that it caused in his characteristics and body systems. Chemical changes were investigated and found to be changing with the temperature.

It was found that there is a visible link between crime peaks and the warm months of the year. Low pressure and low humidity are other key factors in affecting the human body. Warm temperatures are found to cause aggressive behavior and restlessness throughout the entire populus of the country. Cooler temperatures and cloudy conditions are found to cause depression and increase the possibility of suicide. Gravitational affects were found to have little or no effect on the human body.

PREFERRED SEATING IN RESTAURANTS

Hill, Bunker M., A & M Consolidated High School, College Station, Texas 77840; 11º Lee Ave., College Station, Texas 77840

My experiment has shown that the percent of occupied tables by walls is 2.2 times greater than the percent of occupied tables untouched by walls. I therefore concluded that my hypothesis was correct. People do prefer to sit at tables along walls. Through my research, I determined that this will be the case in at least 88% of all restaurants containing both tables against walls and tables which do not touch walls.

I believe that there are several reasons why people chose to sit at tables along walls more often than they chose to sit at tables untouched by walls. One reason is thigmotaxis, which is man's natural fear of exposing his back. Another theory, along the same principle as thigmotaxis, is that people sit along walls so they can keep everyone else in full view. Still another theory is that most restaurants are sociofugal, that is, the way the restaurants are designed tends to keep people apart from one another. My last theory is that people sit at tables near the walls for privacy. All of the above stated factors, with the exception of privacy, are subconscious processes, but they can all be conscious thought processes as well. I believe that not just one of my above stated theories, but a combination of some or all of them are the reasons people choose more often to sit at tables along walls.

So far as my research could tell me, I am the first person to have performed an experiment such as this. For further investigation on this subject, I would try to determine the main reason people chose "wall" tables over tables not located by the walls. I would do this by creating and executing another experiment.

#THE EFFECTS OF FENFLURAMINE ON THE COMMUNICATION SYSTEM OF A NONVERBAL AUTISTIC PERSON.

Ibrahim, Kevin N., North Ogden, Utah 84404
2569 N. 600 E., N Ogden, UT 84404.

Autism is a severe developmental disorder, which among other symptoms, mutes its possessor. My project is based on the idea of the use of computer generated speech synthesis to replace the normal speech that Autistic people lack. This is the third year of a four year project. The first year consisted of proving the feasibility of this concept. The next year was based on prescribed use of an appetite suppressant called Fenfluramine(it has been found to improve learning skills in Autistic people) to improve my subject's accuracy.

This year, improvements were made in the hardware of my project. A computer with a better quality voice has been used. The program itself has been changed to improve speed and ease of use. The use of a "mouse" has eliminated the need for a keyboard, making it compatible for subjects without fine motor skills. For the most part, it is based on improving efficiency without affecting accuracy.

My subject is still on regular doses of Fenfluramine. He has been tested in the exact same environment for all three years. The same test consisting of finding ten random words on the computer has also been used each year. My fourth year will consist mainly of the introduction of sentence structure and the expansion to more than one subject. At least one of these new subjects will not have the motor skills needed to use a typewriter keyboard.

#First Award - American Speech-Language-Hearing Association
Alternate to Scholarship - Ohio State University

NON-DOMINANT HANDEDNESS - RIGHT VS. LEFT

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The purpose of my project was to compare and analyze initial response to non-dominant hand use: right vs. left. Procedure: (1) Discussions with occupational and physical therapists and a visit to Touro Infirmary Occupational Therapy Department showed that standard tests are given and therapy is provided according to rehabilitation needs with no special consideration to hand dominance; (2) Timed tests were developed and administered to right and left handers using dominant and non-dominant hands. The tests involved manipulative skills used to perform every day type tasks; (3) A questionnaire concerning degree of difficulty and frustration experienced was given to individuals who had suffered an impairment of their dominant hand. Results: With non-dominant hand use, left handers performed 5 of the 9 tests faster than right handers. Right handers performed 2 tests faster with their non-dominant hand than the left handers. Right and left handers performed 3 of the tests equally. With forced non-dominant hand use, right handers experienced difficulty ranging from a moderate amount to almost impossible and experienced emotional effects from irritability to depression. Left handers experienced difficulty ranging from a small to moderate amount and emotional experience was mainly frustration. Conclusion: Right handers had more difficulty than left handers adjusting to non-dominant hand use. Left handers would adapt better initially to forced non-dominant hand use.

ASYMMETRY IN CHICKS' RESPONSE TO MEALWORMS

Besmer, Lahdi, Housatonic Valley Regional HS, Falls Village, CT 06031
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According to an experiment done by J. Wallman (1979), the visual preparation a chick gets from seeing its feet is a factor in its ability to recognize mealworms as food. The purpose of this experiment is to test whether this phenomenon is asymmetrical, or whether visual preparation in Leghorn chicks is transferred from one brain hemisphere to the other.

The experimental design used three groups of newly-hatched *Galus galus* chicks. Group 1, Normal Control, had their vision unimpaired. Group 2, Blind Control, had both eyes covered from hatch. Group 3, Experimental Group, had one eye covered from hatch. Those chicks from Group 3 that reached "criterion performance", the behavior set by the Normal Control (Group 1), had their eye cup switched. Their inexperienced eye was tested, and the data were recorded as Group 4.

The data suggest that the behavioral response of a chick to a mealworm is an asymmetrical phenomenon. However, these results were obtained with a limited test sample size due to low winter fertility rates in Leghorns and a stringent criterion performance - pecking the mealworm - for Group 3. It was discovered that newly hatched chicks with one eye occluded have some difficulty in the left/right location of food. Therefore eyeing, pecking, or eating the mealworm is a better Group 3 criterion performance, and will provide larger Group 4 test sample sizes for better statistics in future experiments.

RESPONSE UNDER SENSORY BOMBARDMENT

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The purpose of this experiment was to determine the effects of audio and visual distractions on reading comprehension and computational abilities. Uses for the conclusions obtained in this experiment lie in greater understanding of the distractive capability of media such as radio and/or television.

Thirty subjects were tested. The first group of ten subjects took three sets of tests under normal conditions, and these results were used as a control. The second group, composed of twenty students, were given the tests under varying conditions. The A tests were given without distractions, after which the B tests were given simultaneously with visual distractions - a flashing pattern on a video screen. Last, the subjects were given test C while undergoing audio distractions - a repeated series of noises. All subjects were tested both for the accuracy and the speed of their responses.

In general, the effects of the audio distractions were small, and in some cases, almost negligible. In contrast, the effects of the visual distractions were quite significant, with the subjects' responses being reduced 14 percent.

Considering the results from a practical point of view, a distraction such as a television has a substantial effect upon an individual's intellectual performance. Because of the significantly reduced effect of audio distractions, such as radio, it was found that those distractions, unless deafening, have a far lesser potential to impede intellectual performance. In conclusion, while it may not be very detrimental to study while listening to the radio, television is not advisable to ensure peak performance.

#LEARNING, MEMORY AND ANALYSIS ON DETERMINED SITUATIONS TO MEASURE THE INTELLIGENCE AND CAPACITY OF APIS MELLIFERA.

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The purpose of this investigation is to prove that, besides natural instinct, Apis mellifera, possesses a memory well developed and possibly a good brain system.

In the experiment, I used an acrylic rectangle with a red round cardboard at the end with a hole in the center and every time the bee made a round trip, I continued adding a cardboard obstacle divided in five colors: red, blue, violet, yellow and green, each side having a hole in a different position until ten were completed. I did this procedure using five leader bees. They belonged to a group of five corresponding bee groups. Then I repeated the same procedure, but adding the rest of the colors that appeared on the cardboards obstacles with honey at the end.

In the other part of the investigation, I used the same procedure, with the same group of bees, but I added all cardboards with food and with the same colors of the obstacles and the bee had to cross thru the indicated color. With this I concluded that Apis mellifera is intelligent, because it proved its capacity for analysis, its memory, its learning and its recognition abilities. According to the graphs obtained, they show that the bee, inmediatedly reached the objective, and had no doubt of the obstacles it had to cross.

#Third Award - General Motors ISEF

A Graphic Approach to the Formation of a Musical Composition Derived From a Statistical Survey.

Davis, Kimberly Michelle, Laurel Count Jr. High, London,Ky
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Our first contact with the outside world is believed to begin with the rythmic sound of our mother's heartbeat, therefore musical responses precede linguistic ones. Once a child enters the world of formal schooling, he is already a type of musician in terms of preferences, perception, and knowledge.

The aim of this project is to determine whether or not, from the results of a statistical survey, a musical composition can be formed to create a more soothing environment.

For a statistical analysis to be conducted, the researcher must first survey fifty students that are thirteen and fourteen years old for their favorite tone of the C Major scale. Then the researcher must test the subjects for favorite chords which are selected randomly from a set of chosen chord forms. Afterwards the same survey must be performed on people thirty years of age and older. The results are then statistically analyzed to form two musical compositions.

Taking into consideration the fact that people have different preferences and that different factors affect a person's choice, the researcher predicts the choosing of the tone represented by the letter A and the A Major chord to be favored by the students. The researcher also predicts the selection of the tone G and the G Major chord by people thirty years of age and older.

The results of the survey and conclusion of the project are to be announced at a later date.

DOES LETTER CONFIGURATION AFFECT ASSIMILATION?

Moritz, Valorie, Slayton H.S., Slayton, MN 56172
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Does the shape of lower case alphabet letters affect the speed at which individual letters are learned? Will recognition of letter groups which have been classified according to ease of identification show any correlation to the above?

I compiled test results from one hundred forty kindergarteners and kindergarten testing of fifty third graders to determine the rate at which each lower case letter was learned. Of the twenty-six letters, the lowest percentage known were letters of similar appearance. Letters known by 50%-75% of the students had similar shapes, yet distinctive characteristics. Commonly seen letters such as s, o, and x were known by 76%-100% of the students.

To test my hypothesis, I developed a test by putting letters into groups based on ease of identification and the number of students who could identify them. Sets of three letters (for kindergarten) or five letters (for third graders) were shown for three seconds. Students were to circle the identical group of letters on their test papers.

I found that when comparing individual letter recognition to letter-group assimilation, the range of differences was significant. Letters that are more difficult to recognize are also difficult to remember in groups. My results showed a significant difference for each of the three age groups I tested. Beginning kindergarten girls identified more letters and performed better on the letter group test than did their male couterparts. This indicates the importance of having children recognize and learn the distinctive characteristics and differences in letters both visually and mentally before attempting a reading program. Such learning would start with word configurations of the more distinguishable letters.

#Fourth Award - General Motors ISEF

# ALCOHOL: ITS EFFECTS UPON LEARNING PROCESSES

Barsky, Carol-Lynn, Obion Co. Central H.S., Troy TN 38260
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Alcohol is a very toxic substance that produces a great many changes in the human body. That alcohol affects the memory is a known fact. But, does it also affect other similar brain functions such as the process of learning, and, if so, to what extent? To answer these questions is the purpose of this project.

The procedure which I followed to perform this experiment involved young rats and their prowess in successfully traversing a maze. One group of rats was under the influence of alcohol while performing this feat; the other group was not. A comparison of the number of errors made and the time score of each group helps to show how alcohol affects the learning process. Two separate experiments were made: the first with ¼cc of alcohol and the second with 1 cc (25%).

The complete results of both experiments are found on a chart on the display. The most important factor, the number of errors made, differed drastically between the two groups. In the first experiment, the non-alcohol group made nearly twice as many mistakes as the alcohol group, and, in the second experiment, they made half as many mistakes as the alcohol group. Therefore, ¼cc of alcohol served to improve their performance (probably due to the more relaxed state caused by the alcohol) while the 1 cc of alcohol did impair their functions.

#Alternate to Scholarship - Ohio State University

#ALCOHOL SYNDROME: ITS EFFECT ON PHYSICAL DEVELOPMENT AND LEARNING CAPACITY

Trinh, Thu Huong Le, Spartanburg H.S., Spartanburg, SC
P.O. Box 18276, Spartanburg, SC 29318

The purpose of this experiment was to determine if alcohol ingested during pregnancy could affect the fetal development and learning ability of offspring. Ten female rats and ten male rats were used. They were divided into two groups, the experimental and the control. The control was fed normally with Purina Chow and water. The experimental group was fed as the control except the female rats in this group were injected with two doses of alcohol on the sixth day of gestation. To study the effects on physical development, the average length and body weight of the puppies were recorded and the skin tone examined. Both the weight and length of the experimental puppies were lower than the control. The skin appearance of the control puppies was healthier as compared to the experimental puppies. A discrimination learning task method was used to study the learning ability of the two groups. The data have shown that the experimental puppies learned more slowly than those in the control group. All factors studied showed that alcohol ingested during pregnancy does adversely affect the physical development and learning ability of the offspring.

#Fourth Award - General Motors ISEF
Honorable Mention - American Psychological Association

ROLES OF SENTENCE STRUCTURE AND BRAIN PATTERNS IN LEARNING LANGUAGES

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To discover faster,more efficient methods for learning foreign languages,the sentence structures of common phrases in 12 different languages were torn down and studied.This was done to determine which parts of a language emphasis should be placed upon when it is being learned.Also,experiments were done to find ways to teach all types of learners so that words learned would be stored in Long Term Memory.A test on German verbs was designed so that it would employ visual aids for the right-brained learner,the verb as it would be used in a sentence for the left-brained learner,and a definition of the verb in a pre-test study aid.Results from a pilot test showed that no more than 3 of the 10 answers were ever missed and upon taking the test a second time,the participant did the same or better.At one week later and two weeks later,one participant who was further tested remembered verbs without having studied again.From the sentence structure study it was also found that the sentence structure of a language may be an indicator of the brain mode a native speaker is using when speaking the language.English,Arabic, Danish,Finnish,French,German,Hebrew,Italian,Dutch,Russian, and Spanish were the test languages.They represented the Indo-European,Finno-Ugric,Japanese,and Afro-Asiatic language groups.

#RIGHT BRAIN DOMINANCE AND SPATIAL JUDGMENTS

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This study examined the split-brain theory with its implications for learning differences in the classroom. The researcher tested thirteen and seventeen- year old subjects (60 males, 56 females) at Stanton. Sixty test questions had three divisions: (1) Intellectual activity preference (2) Brain hemisphere dominance test (3) Optical images. The first two sections used pre-tested material, while the third used an opaque projector in testing optical illusions, an addition considered unique to this particular field of study. Findings support the hypothesis that male students tend to be right hemisphere dominant and are superior to females in making spatial judgments, although this becomes less distinct as age increases. Seventeen-year old subjects showed a lesser degree of lateralization between hemispheres and further overall left brain development. Although all seventeen-year olds showed increased ability in both right and left modalities, males slightly surpassed females in actual performance in both areas. Although all groups preferred right brain mode activity, seventeen-year old subjects showed less interest in left mode choices. The researcher concluded that while males are slightly superior to females in right brain preference and performance, age and maturation appear to make a major contribution to equalizing hemisphere achievements.

#Second Award - American Optometric Association and Auxiliary to the American Optometric Association

STATISTICAL ANALYSIS OF GPA AS AN INDICATOR OF PSAT SCORES

Baumgartner, Marc K., Bagley H.S., Bagley, MN 56621;
Rt.2 Box 160, Bagley, MN 56621.

The objective of my project was to test whether G.P.A. is an accurate academic indicator or not. My hypothesis was that G.P.A. is accurate for larger groups of people, but on an individual basis, there are exceptions to the expected results for certain G.P.A. ranges. I began by researching G.P.A., and found that I should compare student G.P.A.'s with their average PSAT scores. The PSAT was chosen as an indicator of academic ability because it is the standard test used by most colleges to test academic ability. With the help of a friend who had done statistical work before, I started setting up a program to process student data consisting of sex, and G.P.A. and PSAT scores. The program was designed to process the data through statistical formulas and print out the results.

From the results obtained, graphs were made to illustrate the results, and correlations were done to show relation significance. For my first conclusion, I decided that with all of the schools combined, the average PSAT scores did go up with increasing G.P.A. ranges. Within the individual schools, there was a rise in the average PSAT score proportional to the G.P.A. range, but the results were less statistically accurate than the schools combined. From my correlations, I concluded that the relationship between G.P.A. was statistically significant for the data I had, and I used this to predict future PSAT and G.P.A. scores.

# A THIRD-YEAR STUDY OF BIRD BEHAVIOR AT WINTER FEEDING STATIONS

Michel, Kimberly K., St. Clair High School, St. Clair, MN 56080
Rt. 1 Box 29, Eagle Lake, MN 56024

Two winter feeding stations were constructed separately during a four month time period. Each station consisted of four platform feeders as well as four suet bags that were of the same design. The feeders were cleaned and filled at regular intervals. Arabic and numerical symbols were placed below each feeder to allow for positive identification of the feeders preferred by each particular bird species. The two feeding stations each dealt with a specific variable. Observations made of the first station were taken when the platform feeders and suet bags were placed at four different heights, whereas observations made of the second station were taken when the platform feeders and suet bags were four different colors. The observations were made of twelve different species of birds at various times of the day during a three month time period. Pictures were taken with a 35 mm while the different species were feeding. My observations indicate that the observed bird species do prefer specific heights above the fround for feeding as well as specific colors of platform feeders and suet bags. The data collected which validates this statement was collected when all other variables remained constant. Bird selection of suet bags for color was found to be unrelated to the birds selection or preference for a specific color in bird feeder platforms. The Chi-square method, which was taught to me by Dr. Merrill Frydendall, was used to validate the data. Once again, more questions have been raised than answers for have been found. Birds have been a field of research as well as a hobby of mine for the past several years and this author will continue to research the many questions that remain unanswered in future studies.

#First Award - General Motors ISEF
First Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society

A STUDY OF THE RELATIONSHIP BETWEEN TRACE MINERAL LEVELS AND BEHAVIOR

Dickey, Leslie M., Cole R-5 High School, Eugene, MO 65032
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The purpose of this study was to determine if there is a relationship between trace mineral levels and deviant behavior. Because human hair is an excellent bio-indicator of the body's total mineral composition, hair trace mineral analysis was used. Hair samples were taken from twenty white Caucasion males between the ages of twenty and twenty-five from each of the following groups:

1) an extrinsic control group of college students
2) an intrinsic control group of non-violent inmates
3) an experimental group of violent inmates

Two control groups were used in order to compare those from the experimental group with those from the "normal" population and with others from the correction facilities who had committed non-violent offenses--thus eliminating the dietary status of the correction facility from being an influential factor.

Two-tenths to three-tenths grams of hair was cut from an area close to the scalp. Hair samples were then analyzed for trace elements present using atomic absorption spectometry. The specific elements studied were copper, zinc, magnesium, and iron.

Based on this study, copper seemed to be a bio-indicator of behavior disorders. The comparison of the experimental violent group and the control college group had a statistically significant difference in the copper levels, with a 90% confidence interval. Although there were some variations in the magnesium and zinc comparisons, they were statiscally insignificant. The iron levels seemed to indicate that they were directly influenced by the diet. Further studies are being done at this time.

# TESTING STRESS: THE EFFECT OF ALTERING THE ORDER OF QUESTIONS OF DIFFERENT LEVELS OF DIFFICULTY, ON THE TEST RESULTS.

Fraser, Adam C., Centennial S. S., Welland, Ontario Canada L3C 3W2
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It has long been suggested that a student should start a test with the easiest question. It is believed that by starting on something the student can handle, the student can build confidence, relieve tension and develop a positive attitude. In order to evaluate this concept, a test was developed, composed of six logic problems. Three problems were easy, two were of moderate difficulty, and one was difficult.

In the first experiment, three groups of Grade Nine students were chosen by Precision Control Matching. In the second experiment, a second set of three groups was chosen by Randomization. Group A students wrote the test questions in any order they chose, Group B from easiest to hardest, and Group C from hardest to easiest. In the first experiment, Group A was allowed to review their answers.

Immediately after the test, the students completed a questionnaire designed to evaluate the level of frustration and stress.

It was found that working from easiest to hardest (Group B) led to the lowest frustration levels. In Experiment 1, Group A received the highest average score, as their higher frustration level was compensated for by the opportunity to review. In Experiment 2, Group B received the highest average score.

#Third Award - General Motors ISEF
Honorable Mention - American Psychological Association

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TEACHERS CHARACTERISTICS THAT AFFECT THE STUDENT'S LEARNING IN THE SCHOLAR DISTRICT OF LUQUILLO

Rodríguez-Rosa, Ricardo E., Rafael N. Coca Jr. H. S., Luquillo, P.R.
Bo. Sabana, Buzón 6432, Luquillo, P.R. 00673

If the teacher's characteristics affect the student's scholastic development... then, when the teacher is aware of this he will achieve academic excellency.

The purpose of this study is to determine how the teacher's characteristics can affect the students scholastic progress.

Ever since the beginning of the Puertorrican man's history there has been a very close relation between the school and man. As time passes, the principles that are tought in school not only in the educational aspect but also in our daily lives, acquire more importance for the human being.

Due to the fact that this is a fundamental aspect in the individual's development, it justifies itself the purpose of studying any factor that affects this, and in this case the characteristics that affect the student's learning has been selected.

Teaching must be done as a team, in which the teacher and the student establish goals in common that interrelate with academic excellency. The teacher must center his teaching on the student and must be aware of his duty as a tutor effectively using the basic principles of educational pshycology.

The excellence of teaching dependes on a combination of common sense, knowledge, ability to teach, enthusiasm, personality, self-control, critical judgement, self-esteem and respect towards othirs.

This searchings arrives to the conclusion that the teacher has to provide learning experiences that lead to an academic achievement and should permit the student to practice the skills taught so that he will developed his cognitive, affective and psycomotor phases.

BEHAVIORAL, BIOLOGICAL AND ECOLOGICAL STUDY OF THE AMERICAN COCKROACH PERIPLANETA AMERICANA.

Pagán, Luis M., Francisco Rodríguez López H.S., Guayanilla, P.R. 00656;
Santa María 25 E-6, Guayanilla, P.R. 00656.

Along with studying the habitat of Periplaneta americana, I have performed an analysis of their escape system.

The movements of any organism through the air generates tiny currents. I found that P. americana flees from possible danger by detecting these currents with an arrangement of very sensitive hairs in their cerci, an amazingly precise wind detector.

With subtle air puffs I tested their ability to locate the source of the currents and to turn away to evade what they think is a threat to their survival.

These orthopterans are very widespread due to the fact that they prefer antihygenic places such as sewage ducts and others.

Biochemical assays are being carried out to determine insecticide effects on their escape systems.

A. assimilis has cercal receptors similar to those of cockroaches. I have found that crickets, like cockroaches; show turning responses to air puffs and to strikes by toads.

ARTISTIC DEVELOPMENTAL STAGES OF CHILDREN

Wright, Linda C., Ogden H.S., Ogden, UT 84403
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The purpose of this study was to determine if children from the ages of five through eleven go through different artistic developmental stages of drawing as they learn to draw themselves.

Over 120 children from the ages of five through eleven were chosen and asked to draw a picture of themselves. After they drew the pictures, the pictures were then gathered and carefully examined in the following seven main areas of examination: 1) stick arms and legs, 2) neck, 3) facial features, 4) arm length, 5) body shape, 6) arm position, 7) hair.

The results then indicate that children from the ages of five through eleven do go through different artistic developmental stages of drawing. The children progress in the following five areas: 1) stick arms and legs, 2) body shape, 3) facial features, 4) neck, and 5) correct arm length.

We then can conclude that children do go through different progressive artistic developmental stages of drawing when they draw themselves.

ESP: FACT OR FICTION ? - A TWO YEAR STUDY

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PROBLEM-Does ESP exist? Do high school students, elementary students, or twins show a high percentage of correct answers?

HYPOTHESIS-I believe that ESP exists in some people. I do not believe that any of the subjects that I test will show an extremely high percentage of correct answers. I believe that twins will show the highest percentage of correct answers, followed by high school students, and then by elementary students.

PROCEDURE-Each pair of subjects sat back to back each having an identical set of cards in front of them. Each subject then alternated being the sender and the receiver with each set of cards(colors, symbols, and numbers). The elementary and high school students were tested with the person with whom they thought had a personality most like and unlike theirs, both male and female.

RESULTS-The percentage of correct answers for high school students -26.5, for elementary students-19.2, and for twins-22.2. I found one pair of female high school subjects that showed an extremely high number of correct answers. These subjects had a score that was 3.50 standard deviations from the mean for alike high school students.

CONCLUSION- I found that high school students had the highest percentage of correct answers, followed by twins, and then by elementary students. I found one pair of subjects that received such a high score that statistics rule out the possiblility of this occuring merely by chance. At this time I am unable to prove if ESP exists.

A SUGGESTED CORRELATION BETWEEN TYPE A BEHAVIOR AND LEFT BRAIN DOMINANCE

Rennerfeldt, Carter R., Williston High School, Williston, ND 58801;
1704 Rose Lane, Williston, ND 58801

Type A behavior, which is exhibited in stress-oriented, overachieving people, is a growing area of medical and psychological concern. It has been determined as being a major cause of coronary heart disease. The purpose of this project was to conduct research and experimentation that would determine if left brain dominance could be a factor of Type A behavior.

Through observations and oral testing, a field of subjects with varying degrees of Type A behavior was ascertained. These subjects were tested further to determine which of their cerebral hemispheres was more dominant. The results of these two experiments, along with information gathered through research, indicated a direct relationship between left brain dominance and Type A behavior. In fact, the degree of left brain dominance correlated closely to the degree of Type A behavior.

In my opinion, the results of this project could be beneficial to the topic of Type A behavior and, ultimately, to coronary heart disease. I believe the correlation I have established could be used in the determination of and the treatment of Type A behavior. Based on my results, a treatment could be developed to sway left brain dominance and, therefore, divert Type A behavior and prevent coronary heart disease.

WHAT ARE THE EFFECTS OF CHOLINE ON THE MEMORY OF HUMANS?

Grootegoed, David J., Lisbon High School, Lisbon, ND 58054;
10 Main, Lisbon, ND 58054.

Hypothesis: Choline will improve the memory of humans over a 5 day, 7 day, and 12 day periods. Purpose: This experiment is to find that choline, a vitamin B-Complex, will improve the memory of Humans. Procedure: I made 4 lists of 30, nonexisting, 2 syllable, words. I gave a group of students 1 list to memorize. I took the lists away from the students for 5 minutes and had them write down as many words that they could remember. I then gave choline to some students for a 5 day, a 7day, and a 12 day period. At the end of each period I tested the student a second time by giving them a different list of words to memorize. I waited 5 minutes and had them write down as many words they could remember. Results: I found from my December 1984 test, that the students that took the choline improved by an average of 3 more words than the controled students. In my January 1986 test, the students that took the choline improved by an average of 5 more words. In my March 1986 test, the students that took the choline improved by an average of 6 more words than the students that took the placebo. Conclusion: I found that choline will improve the memory of students if taken over certain time periods. Through the results of my March 1986 test, I found that it wasn't just psychological, that in fact did improve the memory.

The Influence of Favorite Color, Sex, Age, Eye and Hair Color Upon Wardrobe Color.

Lan Do, Northwest Classen H.S., Oklahoma City, Oklahoma 73107.
3217 Cashion Place, Oklahoma City, Oklahoma 73112.

Studies were performed to determine if favorite color, age, sex, eye color, and hair color influenced the color selection of wardrobes. 419 subjects ranging from age 5 to age 76 completed surveys requesting information regarding their age, sex, ethnic background, eye and hair color, favorite color, most abundant color in wardrobe, and eye and hair color of both parents. Results indicate that: a) favorite color is sex-related, with significantly more males having blue and brown and significantly more females having red, purple, and pink as favorite colors; b) favorite color is also age-related, with increasing preference for blue, green, and yellow and decreasing preference for red, purple, and pink with increasing age; c) favorite color is not related to ethnic background, eye color, or hair color; d) a small percentage of the sample do not have either parent with the same eye and hair color; e) the most abundant color found in wardrobes is sex-related, with males having more blue, brown, and gray while females have more red, purple, pink, and white; f) wardrobe color is not influenced by hair color, and maybe weakly influenced by eye color; and g) wardrobe color is partially influenced by favorite color.

BIOCHEMISTRY

PEROXIDES: CAN THEY BE TERATOGENS?

Rabensburg, Kathleen C., Bastrop H.S., Bastrop, TX 78602
908 Pine St., Bastrop, TX 78602

In this experiment the teratogenic affect of benzoyl peroxide and sodium periodate was investigated. Four groups of twenty female SENCAR mice were mated to sixteen males. The females' backs were clipped and treatments began. One group was given 200 mg. of Clearasil applied topically, another was given 0.1 mls. of $NaIO_4$ diluted in 2.0 mls. of 3% acetic acid also applied topically. One of the two control groups was given 0.1 mls. of acetone applied topically, the other was not treated. The percent of total births born dead was 12.7, 16.4, 2.8, and 7.6 respectively for benzoyl peroxide, sodium periodate, acetone, and control treated groups. A significant increase in the total number of deaths within 24 hours was seen between the sodium periodate and acetone treated groups. A significant increase in the total number of deaths was also seen between the benzoyl peroxide and acetone treated groups. Comparison of the total number of live births demonstrated a significant decrease between the sodium periodate and control treated groups. Whereas a significant increase in the total number of live births was seen between the benzoyl peroxide and acetone treated groups. These findings suggest that benzoyl peroxide and sodium periodate were not teratogenic.

STUDIES ON THE REGULATION OF ALKALINE PHOSPHATASE BIOSYNTHESIS AT TRANSCRIPTION AND TRANSLATION LEVELS; II: cDNA CLONING IN VIRAL VECTORS

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This study is intended to identify factors that regulate transcription and translation levels involved in the biosynthesis of alkaline phosphatase (ALP). Since these mechanisms are virtually unknown in mammalian cells, this research may provide vital information. As an initial step to identify such regulators, cells that produce active ALP and those lacking ALP must be compared at the genetic level. Thus, transcription and translation components from long and short term cultures were isolated and compared. mRNA was isolated by a combination of density gradient centrifugation, organic solvent extraction, and affinity chromatography. Translation products were qualitatively analyzed by electrophoretic migration patterns of ALP specific immunoprecipitable polypeptides. Observations from my research over the last four years have clearly established that the biosynthesis of ALP is primarily regulated by factors exerting control at the level of transcription. The present objective of this experiment is to clone cDNA encoding ALP for use as a probe in studying the mechanism by which ALP is expressed. At the present, ssDNA and dsDNA was successfully reversely transcribed from purified mRNA. The double-stranded cDNA was then linked with synthetic olibonucleotides which were spliced by restriction endonuclease EcoRI to produce sticky-end fragments. This cDNA will then be incorporated into the powerful expression vector lambda gt11. This unique viral vector is capable of directing host cells to produce protein fragments encoded by recombinant cDNA. cDNA clones are then readily recognized by immunoscreening procedures. These studies may eventually enable one to identify, isolate, and characterize promoters, enhancers, and proteins that regulate the transcription of mRNA coding for ALP.

FLUORESCENCE ENERGY TRANSFER IN ACTIN

Trueman, Daniel, Shoreham-Wading River High School,
Shoreham, N.Y., 11786;
55 Highland Down, Shoreham, N.Y. 11786

Fluorescence energy transfer was used to examine the structure of actin. 5-eosinthiosemicarbazide (EC) was reacted covalently with the amino terminus (a previously unlabeled site) and 5 iodoacetamido-fluoroscein was attached to cysteine 374. Energy transfer between these two fluorophores was used to determine their relative proximities in both fibrous (F-actin) and globular (G-actin) actin. A distance of 30 A to 40 A was estimated between cys 374 and the amino terminus of adjacent monomers in the filament. An even smaller distance was determined between the same two residues within the G-actin monomer. Several unresolved variables made precise calculations impossible. This information, however, is still useful in defining the structure of actin. Additional studies should allow more precise measurements to be made. In addition to all the above studies, EC bound non-covalently to actin was analyzed and the intrinsic fluorescence of actin was used to examine the effects of all the fluorophores on the polymerization of the protein.

#First Award - American Medical Association
Third Award - General Motors ISEF

THE EFFECTS OF SELELNIUM ON VARIOUS ORGANISMS

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2500 Tanglewood, Ruston La. 71270

This experiment was conducted to determine the effects of selelnium upon various organisms.

BACTERIA (*Mycoides*)-Two flasks of triptic soy agar were prepared, one with 1/100 parts Se and one without. Both were innoculated under sterile conditions with *Mycoides* bacteria and placed in an incubator. The group with the Se grew decidedly better than the control, but the accelerated growth halted when Se pellets were added to a plate already containing Se.

FLATWORMS (*Dugesia tigrina*)-The planaria were placed in Se/water dilutions of 1/100,000; 1/1,000,000; 1/10,000,000; 1/100,000,000; 1/1,000,000,000; and a control of water. The planaria in the water and the dilutions of 1/1,000,000,000; 1/100,000,000; 1/10,000,000 all survived, while the rest died.

SEEDS (*Vigna unguicalata*)-The seeds were placed in Se/water dilutions of 1/10, 1/100, 1/1000, and a control of distilled water. Only the control seeds germinated.

FUNGUS (*Alternaria*)-Two flasks of triptic soy agar were prepared, one with Se (1/100) and one without. The media were innoculated with the fungus, and though the control group grew faster over a period of 48 hours, the group containing Se soon supassed it in growth.

In conclusion, Se in trace amounts enhances the growth of bacteria, but the accelerated growth stops in larger doses. Se proportions greater than 1/10,000,000 are toxic to planaria. Se inhibits the growth of fungi. Selelnium inhibits seed germination.

BIOCHEMICAL CHANGES IN RATS TREATED WITH HEAVY METALS.

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The behavioral and biochemical effects of cadmium chloride, mercuric chloride and lead chloride were studied in male Sprague-Dawley rats. The biochemical effects in terms of changes in Ca^{2+} pump activity of brain P_2 fraction and in heart sarcoplasmic reticulum both *in vitro* and *in vivo* were analyzed. Both $^{45}Ca^{2+}$ uptake and Ca^{2+} ATPase activity were found to be inhibited by micromolar concentrations of heavy metals and the inhibition was dose dependent. Administrations of heavy metal (25 and 50 mg/kg body P.O.) similarly decreased Ca^{2+} pump activity of both -- Brain P_2 fraction and heart sarcoplasmic reticulum, indicating disruption in membrane transport mechanisms. In the presence of calmodulin, a calcium regulator protein, the pattern and extent of inhibition were different from that obtained in the absence of calmodulin, suggesting metal interaction with calmodulin regulated reaction sequences. The toxic potentially of the heavy metals tested and degree of sensitivity of tissues remained the same both *in vitro* and *in vivo*. Toxic potentiality: $CdCl_2 > HgCl_2 > PbCl_2$. Tissue sensitivity: Brain >Heart.

THE EFFECTS OF DIFFERENT ANTIGENS ON *MUS MUSCULUS*

Bullard, Dana J., North Fort Myers H.S., North Fort Myers, FL 33903;
2139 West Lakeview Blvd., North Fort Myers, FL 33903.

The purpose of the third phase of this experimenter's project was to stimulate a specific defense of an immune reaction in four *Mus musculus*.

The third phase of this two year study consists of three parts. The experimenter injected .10 cc of a killed vaccine of Feline Panleucopenia(Rhinotracheitis - Calici Virus) into four *Mus musculus*. The injections were on an interval of 20 to 26 days apart. Blood samples were taken before the injection and up to two weeks after the injection. Weight was taken every other day.

The results of A and B were inconclusive due to improper experimental techniques. The nonfiltration of the Wright's stain caused the stained crystals to attach themselves to the leukocytes, and the cells were thus indistinguishable. In part C, the experimenter sent two samples of *Mus musculus* serum to the Cornell Diagnostic Laboratory for a titer test. In sample C, the hemagglutination inhibition for Feline Panleucopenia was 1:640, the virus neutralization test for Feline Viral Rhinotracheitis was -1:40, and the virus neutralization test for Calicivirus was -1:40. In sample D, the hemagglutination inhibition for Feline Panleucopenia was 1:20, the virus neutralization test for Feline Viral Rhinotracheitis was -1:40, and the virus neutralization test for Calicivirus was -1:40.

The conclusion of these findings show that once the immune system detects an antigen, an antibody is produced to combat the antigen. Every time the antigen enters the body, the immune system will produce a higher amount of antibodies to destroy the antigen. This researcher believes that with these experiments the public will better understand the observations made by individuals doing leukemia research.

THE CRYSTAL STRUCTURE OF NARINGENIN AND ITS ROLE IN THE INHIBITION OF ARYL HYDROCARBON HYDROXYLASE

Erlebacher, Jonah D., Cheltenham H.S., Wyncote, PA 19095;
7733 Mill Rd., Elkins Park, PA 19117.

Naringenin is one of a group of compounds called flavonoids, which inhibit the actions of the enzyme aryl hydrocarbon hydroxylase (AHH). This enzyme is responsible for the activation of carcinogenic polycyclic aromatic hydrocarbons (PAHs) such as are found in cigarette smoke. The crystal structure of naringenin was determined in order to compare its structure to other known inhibitors of AHH. Naringenin crystallises in the monoclinic space group $P2_1/n$, with cell dimensions: $a=4.926(1)$ Å, $b=15.423(3)$ Å, $c=16.445(3)$ Å, $\beta=92.86(1)$. Naringenin packs within the unit cell by a hydrogen bond between H12 and O3, and by van der Waals attraction. The overlap of certain carcinogenic PAHs revealed a rough active site shape for AHH. Theories of the mechanism of inhibition, inferred from the structure of naringenin, showed more clues about this area of the enzyme. The aim of this research is to learn more about the enzyme AHH, so that more specific and more potent inhibitors can be discovered or synthesized, and the activation of carcinogenic polycyclic aromatic hydrocarbons can be prevented.

* BIOLOGICAL AGENT CONTROLS INSECT NEUROHORMONE

BROWN, ERNEST G., ELEANOR ROOSEVELT H.S., GREENBELT, MD 20770
48 LAKESIDE DRIVE, GREENBELT, MD 20770

Problem

Every year insect pests cause billions of dollars in damages to american agriculture. In the past these insect pests were treated chemically; however, researchers are now trying to biologically control insect pests.

Hypothesis

One approach to the biological control of insect pests may be to interfere in the insect's normal life functions by using substances already within the insect.

Approach

In 1969, Mayer and Candy identified an adipokinetic neurohormone located in the locust corporus cardiacum. This adipokinetic neurohormone (AKH) was found to release the stored energy from fat bodies for insect flight. Using this information, I tried to identify the same adipokinetic neurohormone in the corn earworm Heliothis zea, a common pest of corn. My approach was to create a new methodology that would monitor the picomole amounts of AKH material and to create an original, biological means of intervening in its normal flight function.

Findings

Results demonstrated an ability to monitor the picomole amounts of Heliothis AKH in the corpora cardiaca using High Pressure Liquid Chromatography. This new methodology allowed me to follow the biological function of HAKH in flight. By using octopamine, a biogenic amine already within the Heliothis, I am able to control the insect's AKH activity; thereby, controlling the insect's ability to fly, mate, and feed.

*Scholarship - United States Navy/Office of Naval Research
Second Award - Entomological Society of America
Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Third Award - General Motors ISEF

THE EFFECTS OF DMSO AND AZIUM ON THE HEPATIC FUNCTIONS OF LABORATORY RATS PHASE II

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DMSO and Azium are anti-inflammatory drugs used to treat leg ailments in animals and also illegally by humans. Research is unclear about the safety of such usage. The purpose of this study was to investigate the effects of DMSO and Azium on the blood levels of GOT, GPT, and LDH in laboratory rats. These have been shown to be an indication of healthy liver function. Twenty laboratory rats were divided into 4 experimental groups. One group was a control, One was given a dose of .2 g of DMSO gel for 18 consecutive days, the third group was given a dose of DMSO plus .5 ml of Azium mixed with it for 9 days, and a 4th group was solely given .7 ml of Azium mixed with petroleum jelly for 9 days. At that time the rats were anesthetized and a blood sample was taken by heart puncture. These were analysed for GOT, GPT, and LDH. Kidneys and spleens were weighed and liver tissue samples taken. A one-way analysis of variance showed that there were significant differences ($p < .05$) between groups for all variables. In addition, severe hepatic distress showed in the form of white blotches and dark discoloring of the liver. The tissue samples sent to the state veterinary laboratory revealed hepatitis. More research is necessary to determine whether similar results occur in humans.

# PHYTOALEXINS : KEY TO DISEASE-FREE ROSES

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The purpose of this project was to determine if Black Spot-inhibiting phytoalexins could be isolated from classical roses.

Various solvent combinations, coupled with both paper and thin layer chromatographic procedures, were used to isolate the furan phytoalexic compound. This process resulted in the use of a three per cent sucrose solution as extractant, a solvent combination of butanol:ethyl acetate:water 40:40:20 v:v and ethanol: chloroform 90:10 v:v, and silica gel with fluorescent indicator TLC. The suspected etiologic agent of Black Spot was isolated and cultured in order to test the anti-fungal properties of the furan phytoalexic compound. The pathogenicity of this culture was confirmed by studies following the principle of Koch's Postulates.

The results of the inhibition and chemical tests confirmed the activity of furan phytoalexic compounds in classical disease-resistant roses. Potential applications of this work are described.

#First Award - United States Navy/Office of Naval Research
Fourth Award - General Motors ISEF

IDENTIFICATION OF NOVEL SEQUENCES INSERTED INTO THE HUMAN CELLULAR-MYC GENE

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DNA, prepared from a breast tumor tissue sample and digested with the restriction endonuclease EcoRl, was shown by Southern analysis to contain both an amplification and a rearrangement of the C-*myc* locus. One portion of the rearrangement, a 4.1Kb *EcoRl* fragment, containing the C-*myc* third exon was cloned into the lambda vector GT11 and subsequently subcloned into the plasmid pBR322. This fragment was then mapped using a series of restriction endonuclease digestions; after which, the fragment was sequenced at the nucleotide level. Finally, the entire sequence (≅ 2400 bp) was compared with all available primate sequences and shown to contain homology to the moderately repetitive DNA sequences known as the Kpn family. The rearrangement of the c-MYC locus is the first even occurring between MYC exons two and three that has been clearly demonstrated to disrupt the formation of MYC protein.

#Operation Cherry Blossom Trip Award - United States Army
Third Award - General Motors ISEF

BIOSYNTHESIS OF NEUROTRANSMITTERS BY THE DECARBOXYLATION OF AMINO ACIDS

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No exhibit.

#A BIOCHEMICAL ANALYSIS OF ATTRACTING AND NEMATICIDAL AGENTS IN THE NEMATOPHAGOUS FUNGUS *ARTHROBOTRYS CONOIDES*

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The first purpose of this study was to analyze and partially characterize the chemical nature of the nematode attracting substance known to be produced by the fungus *Arthrobotrys conoides*. Methods were designed to determine range of fungal attraction, diffusability in agar, and ability to attract nematodes when exposed to various physical conditions. Paper chromatography showed crude fungal extracts to be ninhydrin positive in a butanol-acetic acid-water solution and an eluate (6.3-6.5cm) was found capable of attracting nematodes. Three amino acids with similar Rf values in the same solvent system were tested for nematode attraction, as were known plant hormones and growth regulators of various concentrations. None of the amino acids, nor IAA, GA, kineton or cyclic-AMP had a significant effect on nematode migration. The second purpose of this research was to determine if a chemical nematoxin is produced by the fungus and, if so, if it can be isolated through electrophoresis and column chromatography. Testing indicated the presence of a chemical nematoxin, although data did not support the hypothesis that the toxin was oxalic acid. Electrophoretic testing at a pH of 8.6 was unsuccessful in separating proteins within the fungus. Gel filtration separated the fungus into 97 components and experimentation has isolated the agent which is believed to be the toxin. If the chemical attractant can be similarly isolated, the two chemicals can be synthesized for commercial use.

#First Award - American Phytopathological Society
Fourth Award - General Motors ISEF

EFFECTS OF STEROIDS ON HORMONE SENSITIVE LIPASE IN NORMAL AND DIABETIC MICE

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Dehydroepiandrostrone (DHEA) fed at 0.4% and the etiocholanolones (ET), both alpha and beta, administered at 0.1% in the diet are known to exert therapeutic effects in diabetic mutant mice, as characterized by lower blood sugar concentrations, prevention of the degranulation of the beta cells of the pancreas, and a reduction in the rate of weight gain. The objective of this project was to investigate how these diets bring about a reduction in weight gain. In order to determine this a series of lipolytic studies on hormone sensitive lipase in epididymal fat pads were carried out on DHEA and ET treated and control chow fed mice of the two species C57B1/Ks and C57B1/6. The steroid diets were shown to increase the rate of lipolysis, as shown by an increase in the activity of the hormone sensitive lipase, in the genetically diabetic mice to near normal levels. There were no sex differences, and alpha and beta ET were equally effective and, in agreement with previous findings, had greater beneficial effects than DHEA. The ability of these compounds to increase lipolysis suggests that this is the mechanism by which the diets reduce the rate of weight gain in these animals.

First Award - United States Army
Fourth Award - General Motors ISEF

SYSTEMIC HYPERTENSIVE SYNDROME INDUCED BY RENIN AND ANGIOTENSIN II UTILIZING CATHETERIZATION IN ALBINO RATTUS NORVEGICUS

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Hypertension affects approximately twenty per cent of the people in the United States. It is a major contributing factor in heart attacks and strokes. Thus, the objectives of this investigation were: (1) To ascertain the effect of renin on the hypertensive syndrome, (2) To determine the Angiotensin II level as related to renin production, and (3) To determine the role of Angiotensin II as a potent vasopressor in hypertension.

Keeping these parameters in mind, it was hypothesized: (1) Renin, a proteolytic enzyme, will cause a definite increase in diastolic and systolic pressure, (2) The level of Angiotensin will be directly proportional to the production of renin, and (3) Angiotensin II invaribly alters the fluctuation of hypertension in studied subjects.

The basic procedural process was as follows: (1) Obtained specimens from the animal lab, (2) Anesthesized specimen using pentobarbital (35 mg per kg of body weight), (3) Catheterization was performed using the jugular vein and carotid artery, (4) Connected to blood pressure machine, and (5) Injected periodic doses of substances to be tested (renin and Angiotensin II).

It was concluded that renin does indeed cause a definite increase in the mean blood pressure and that Angiotensin II also has a direct effect on the elevation of blood pressure. Therefore, there is a direct link between renin and the hypertensive syndrome.

Further research will involve the study of metabolic inhibition.

Research was supported by Morehouse School of Medicine and Grady Memorial Hospital.

SHOCK-CHLORINATION: INHIBITING BACTERIAL GROWTH IN WELLWATER

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People use bleach as a sanitizing and purification agent in wells. Many do not know the amount that is needed to actually purify the water. The purpose of this project was to find the minimal concentration of bleach needed to inhibit bacterial growth in wellwater.

The laboratory procedures consisted of a bacterial dilution series and the production of antimicrobic solutions containing different percentages of bleach. After chlorinating the water with the calculated amount, water samples were plated to check bacterial growth. Titration tests were used to determine the percentage of chlorine in the water.

The results of the antimicrobic dilutions indicated that .005% bleach was the minimal inhibiting concentration for bacterial growth. Through cross-multiplication it was concluded that 1.5 gallons of household bleach were needed for each 3000 gallons of wellwater pumped. The titration tests revealed that the farm well needed to be rechlorinated approximately every two months as 3000 gallons of water would be used during this time. Titration tests confirmed these figures.

#First Award - National Water Well Association
Second Award - General Motors ISEF

A THREE YEAR STUDY WHICH SHOWS THE EFFECTS OF TESTOSTERONES AND ESTROGENS ON SPATIAL LEARNING AND BRAIN HEMISPHERE SIZE IN FEMALE RATS

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The purpose of this project was to investigate the influence of testosterone and estrogen, the male and female sex hormones, on spatial learning and brain size. The researcher observed that female rats which received testosterone and a mixture of testosterone/estrogen learned to run a maze faster than a control group. In addition, the group of rats that received only estrogen exhibited a much slower learning rate than the control group.

Twelve rats were run through a "T" maze three times and their times were recorded. After the third run, three of the rats received estrogen, three rats received testosterone, three received both hormones, and three served as a control group. It was observed that the times of both the testosterone and testosterone/estrogen groups were noticeably faster than the times of the estrogen and the control groups after the hormones were given.

After the completion of the spatial tests, the rats were euthanized. Their brains were removed and the hemispheres were separated. Each hemisphere was then weighed separately. The entire brain was larger in the groups receiving testosterone and both hormones. The right hemispheres of these two groups were substantially larger than the left. In the estrogen group, the brain was smaller than normal, and the left hemisphere of the brain was larger than the right.

It appears that testosterone and a mixture of testosterone/estrogen increase spatial learning and enlarges the brain, especially the right side, while estrogen slightly retards brain growth, particularly on the right side.

#DIABETES AND THE BASEMENT MEMBRANE

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Preliminary studies were performed to deterime the effects of insulin and sorbinil treatments on the basement membrane in order to establish key factors in the prevention of long-term diabetic complications. The EHS tumor was used as a model of basement membrane component synthesis within streptozotocin induced diabetic C57 Black mice. The studies showed a marked increase in the net charge of the basement membrane proteoglycan molecules due to insulin and a decrease in the net charge due to sorbinil treatments.

The current research presented this third year stems from the fact that sorbinil, at doses substantially lower than those of the first year, cause a significant stimulation of EHS tumor cells in vitro. An in vivo procedure consisting of various doses of sorbinil treatment was carried out. The proteins from the murine tumors were extracted and chromatographed on DEAE ion-exchange columns to obtain the data. Sorbinil is still seen to alter the qualitative nature of the proteoglycan molecule, a condition which could impair the normal functioning of the molecule in the basement membrane matrix. Thus, sorbinil seems to be an ineffective elixir for the maintenance of the basement membrane and, therefore, an ineffective treatment for the long-term complications of diabetes.

#Second Award - General Motors ISEF

* KINETICS OF SUCROSE HYDROLYSIS AND INVERTASE THERMOINACTIVATION

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The kinetics of invertase (pH 4.7) and acid (HCl pH 1.2) catalyzed hydrolysis of sucrose were compared and the thermoinactivation of the enzyme invertase investigated. The extent of hydrolysis was determined by colorimetric assay based on the reduction of 3,5 dinitrosalicylic acid (DNS) to 3-amino-5-nitrosalicylic acid (ANS) by the reaction products glucose and fructose. The absorption band about 540 nM was measured on a home constructed colorimeter. Specific rate constants were determined for invertase catalyzed hydrolysis between $0^{\circ}C$ and $70^{\circ}C$ and between $21^{\circ}C$ and $33^{\circ}C$ for acid hydrolysis. Both reactions were run under saturated substrate conditions and followed zero order kinetics. The specific activity of the invertase sample was determined to be 1794 U/mg protein ($25^{\circ}C$). The turnover numbers ($25^{\circ}C$) were found to be 4030 sucrose molecules hydrolyzed per invertase molecule per second and 4.84x10^{-5} sucrose molecules hydrolyzed per H_3O^+ per second. Activation energies were 26.3 kcal/mole for acid catalyzed hydrolysis and 10.2 kcal/mole for invertase catalyzed hydrolysis. A departure from the Arrhenius law occured above $40^{\circ}C$ due to thermoinactivation; however, invertase samples incubated below $55^{\circ}C$ and subsequently cooled regained activity. Above $55^{\circ}C$ activity was progressively lost. It was therefore concluded that the thermoinactivation occuring above $40^{\circ}C$ involves both reversible and irreversible processes.

#First Award - General Motors ISEF

THE DETERMINATION OF AMINO ACIDS IN VARIOUS ALGAE

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Many areas of our world are experiencing hunger today. In order to eradicate this hunger a nutritional, yet cheap, food must be produced in large quantities. Therefore, I have decided to do a detailed study on the nutritional value, especially the amino acid content, of algae that can be grown cheaply in the world's oceans.

Algae have an ability to grow on cheap materials in small areas and many types are known to have a high protein content and a good amino acid balance. These facts make algae appear to be a candidate for the food source that will eradicate world hunger. Will the algae Chlamydomonas, Chlorella, and Spirogyra qualify?

To begin my search for the answer to this question I decided to design a test that would allow me to identify the amino acids found in algal protein. To do this I first established three algal cultures. Then, in order to run a paper chromatography, an established method of seperating amino acids, I had to experiment with different methods of algal preparation. It was necessary for me to rupture the cell walls to obtain the protein and then it was necessary to break the proteins into amino acids so that the chromatogram could be run.

From my experimentation I can only state that the amino acids of Spirogyra can be identified. I have no evidence to support a statement on the nutritional value of algae because much further research and experimentation are necessary.

#EVIDENCE THAT THIOREDOXIN IS REQUIRED FOR BINDING OF THE GLUCOCORTICOID RECEPTOR TO DNA

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To regulate gene transcription, steroid receptors must bind to DNA. I am studying DNA binding of glucocorticoid receptors. Receptors in liver cytosol were bound with (^{3}H) steroid and cytosol was heated at 20°C to permit receptors to transform to the DNA binding state. Steroid binding was measured by charcoal extraction and DNA binding by binding to DNA-cellulose. I found that when cytosol containing (^{3}H) steroid-bound receptors was separated from small molecules by filtering it through a column of BioGel A.5M, the receptor is no longer transformed to the DNA binding form when it is incubated at 20°C. If boiled cytosol or a fraction of boiled cytosol containing molecules between 2,000 and 20,000 daltons is added back, the receptor will bind to DNA, even without heating. Rat thioredoxin purified to 80% of homogeneity also permits DNA binding. Treating transformed receptor in cytosol with methyl methanethiosulfonate (MMTS), a sulfhydryl modifying reagent, causes it to lose its ability to bind to DNA and the inhibition is reversed by dithiothreitol (DTT). Thus, SH groups are required for DNA binding. If the MMTS-treated receptor is filtered through Sephadex G-50, the receptor does not bind to DNA in the presence of DTT. If both DTT and boiled cytosol or purified thioredoxin are added back, the receptor binds to DNA. Thioredoxin is a heat stable reducing protein with a molecular mass of 12,000 daltons, and these experiments give the first evidence that thioredoxin is required for DNA binding of any hormone receptor.

#Third Award - General Motors ISEF

#THE SYNTHESIS AND BIOCHEMICAL EVALUATION OF NATURAL ESTRADIOL ANALOGS IN CANCER CHEMOTHERAPY

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Breast cancer is the most common malignancy in the Western Hemisphere. Direct evidence implicating a role for estrogens in supporting the growth of breast tumors has been gained through cell cultures of neoplasmic human breast epithelium (MCF-7) cells. In this study, two estrogen analogs were synthesized in the hopes of producing compounds that can compete with etradiol and accept sulfate during estrogen sulfyrlation by the removal of the phenolic OH of estradiol from the 3 position to the 2 and 4-positions. By removing the phenolic OH from the 3 to the 2 position, the steroid does not become sulfated when activated with estrogen sulfotransferase. It has been demonstrated for the first time that 2-OHestra-1,3,5(10)-triene-17βol does act as a competitive inhibitor which can play a key role in blocking the growth of mammary tumors. This study will lead to further in vivo testing in mice.

#First Award - General Motors ISEF
First Award - United States Air Force
Second Award - American Chemical Society

#AN INVESTIGATION OF SINGLE-STRANDED NUCLEIC ACID-HDP INTERACTION

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The purpose of the study was to understand the contribution of nucleic acid negative charges to single-stranded nucleic acid - protein interactions. For both SSB and T4G32 proteins, the binding strengths were investigated and compared using oligonucleotides with adjacent negatively charged nucleotide linkages ($d(Tp)_{10}$) and with alternating negative and neutral linkages ($d(\tilde{T}pTp)_4TpT$).

Two measurement methods were used, both based on fluorescence techniques. Both SSB and G32P are fluorescent by themselves, but their fluorescence is lowered (quenched) when the protein binds to a nucleic acid. The pattern of quenching provides a measure of the rates and levels of binding. An alternate technique used the fact that both proteins also bind to the poly(EA) molecule, whose fluorescence increases dramatically when it binds to a protein. Levels of fluorescence enhancement were compared for protein added to only poly(EA), and protein added to poly(EA) plus one of the oligonucleotides.

It was found that negative nucleotide linkages and alternating negative and neutral linkages exhibit almost identical binding patterns. Relative to G32 protein, SSB protein has a much higher affinity for poly(EA) and both types of oligonucleotides. Poly(EA) reaches a saturation point (0.095 and 0.375 protein per nucleic acid residue) for both SSB and G32 proteins. Both the G32P and SSB are quenched 50-55% by $d(Tp)_{10}$ and 40-45% by $d(\tilde{T}pTp)_4TpT$.

#First Award - American Medical Association

Sucralfate: Effectiveness of a Cytoprotective Agent in Ulcer Therapy

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The purpose of this study was to examine the durability of Sucralfate's ulcer-adherent complex in the presence of varying amounts of Hydrochloric Acid (HCL), pepsin and albumin. Its effects on bacterial growth were also tested.

Pieces of raw chicken meat were used to simulate the surface of an ulcer. Six experiments were conducted using Sucralfate in varying amounts of HCL. One experiment was conducted subjecting Sucralfate to gastric motility in full strength HCL(pH2). Eight experiments were completed to examine Sucralfate's effects on bacterial growth. Four experiments were conducted using Sucralfate in an albumin and pepsin environment.

Sucralfate coated and protected the chicken meat well in different strengths of HCL. Motility did not adversely effect Sucralfate's binding action. In the beakers containing Sucralfate, no bacterial growth was noted. Sucralfate adhered well to the chicken meat that was coated with albumin and pepsin.

Data from these experiments indicates that: 1) Sucralfate quickly adhered to a raw surface in the presence of HCL, albumin and pepsin, thus protecting the ulcer and aiding in recovery, 2) Sucralfate discourages bacterial growth in the gastric tract and 3) Sucralfate works most effectively in low to middle concentrations of HCL.

EFFECT OF G_1 FACTORS ON PROGESTERONE OR MITOTIC FACTORS-INDUCED MATURATION OF OOCYTES

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Earlier studies by Sunkara *et al.* (1979) have indicated that the biochemical mechanisms of cell cycle regulation are mediated by different sets of protein factors. It has been shown that certain factors present in mitotic cells can induce condensation of chromosomes and breakdown of the nuclear membrane. Such factors are named mitotic factors, and extracts from mitotic cells which presumably contain such factors can induce germinal vesicle breakdown and chromosome condensation upon injection into *Xenopus* oocytes. On the other hand, Adlakha *et al*(1983)) have demonstrated the existence of inhibitors of mitotic factors(IMF), or G_1 factors, which seem to counteract the activity of the mitotic factors. Thus, it would seem that a cell's stage in the cell cycle is dependent upon the interaction and relative concentrations of the two factors.

In this study, I have attempted to better characterize inhibitors of mitotic factors(IMF). I have reproduced with similar results the data of Adlakha *et al*(1983). in which extracts of G_1 cells did have a profound and inhibitory effect on a mitotic extract's ability to induce GVBD. To investigate further the activity of G_1 factors, the effect of G_1 factors on progesterone-induced maturation of oocytes was explored. Does progesterone stimulate maturation by way of mitotic factors? If so, can G_1 factors block progesterone-induced maturation? Results of such an experiment can give insight into hormone action and the universality of MF/IMF actions. The experimental manipulation with G_1 factors yielded abnormal oocyte maturation.

AN ANALYSIS OF THE INHIBITION OF CYTOCHROME P-450 BY KETOCONAZOLE.

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Ketoconazole is a new orally active, antifungal agent. It is becoming increasingly popular because of its potency and wide spectrum of activity. This drug is a part of the imidazole class and has been heralded as a major advance in the systemic treatment of internal fungal infections. There is some doubt in the administration of this drug because it is believed to inhibit the action of the Liver microsomal enzyme, Cytochrome P-450. This important enzyme is central in the activation and oxidation of many drugs.

The procedures and conditions for the main experiment were determined using many different assays in which the incubation time, substrate concentration, and enzyme concentrations were varied. After the procedures and conditions were determined, assays were performed to test the inhibition of Cytochrome P-450 by Ketoconazole both *in vivo* and *in vitro*.

It was found that Cytochrome P-450 inhibition occurred both *in vivo* and *in vitro*. The inhibition decreased as the drug was allowed to remain *in vivo* a longer amount of time, and after 24 to 48 hours, there was no inhibition. Inhibition *in vitro* was found to be dependent upon the dosage of Ketoconazole administered. More research is needed to conclusively prove inhibition and to determine at what dosage the detrimental effects of Ketoconazole are at their lowest while the positive antimycotic effects of the drug are at their highest.

#Second Award - United States Air Force

THE RABBIT TEST : PHASES V AND VI

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The reproductive capabilities of some animals can have disasterous effects upon their environment. The ultimate objective of experimentation is to find a feasible way of controlling animal populations in the wild without the use of animal drives. Earlier experimentation has suggested the idea of using oral steroids to control the populations of animals as done in human society today.

Phase V tests the effects of oral steroids on the adult male rabbit reproductive system via the ingestion of steroid and mating of the rabbits. Phase VI undertakes to determine whether or not birth control pills may be used as sex manipulators in rabbit populations, as well as determining if there exists a correlation between the use of birth control pills and sex of subsequent offspring in humans. The rabbit population was tested directly, steroids were introduced during gestation, and the human population was tested by survey.

The steroids caused a dramatic decrease in the males' ability to reproduce. 3 of the 4 males were rendered sterile. The other male produced a healthy litter of 6. Birth control pills may be used as sex manipulators in rabbits, according to data; an increase of 100% in percentage of males. The pills caused an increase of 5% in the production of males, but this increase is slight when the human population was viewed holistically.

DO SYNTHETIC SWEETENERS HAVE AN EFFECT ON THE METABOLISM OF ARTEMIA?

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The effect of different concentrations of aspartame and saccharin were studied on the hatchability of brine shrimp (genus *Artemia*) eggs, newly hatched and four-week old brine shrimp. The brine shrimp eggs, in the presence of aspartame, hatched slightly earlier, but these shrimp in the 5 mM aspartame solutions died within 24 hours. Shrimp hatched in the control solution and then placed in the aspartame solutions do not exhibit this increasing death rate. At the end of 10 days, only 10% of the 2.5 mM aspartame shrimp and 5% of the 5 mM aspartame shrimp survived (initially there were 100). In the control group, 50% of the shrimp survived at the end of 10 days. Of the 50 four-week old shrimp placed in the aspartame solutions, only 8% of the 2.5 mM and 2% of the 5 mM survived at the end of 5 days. This is compared to the 19% that survived in the control group during the same time period. The aspartame shrimp exhibited a color change (from red to yellow) unlike the other groups. The shrimp lipids were elevated in the saccharin groups as determined by thin layer chromatography. The TCA precipitable proteins were high in the aspartame groups. Further, on SDS polyacrylamide gel electrophoresis, additional protein bands were noted in the aspartame groups. This study shows that aspartame is toxic to brine shrimp during the early development and affects the protein metabolism.

THE CHEMISTRY OF "HARD COOKING"

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I answered 6 questions derived from "extraneousities" in a hard-boiled egg recipe: Why start with - eggs at ROOM TEMPERATURE? -COLD WATER? -SIMMER, not BOIL? -POKE A HOLE in the large end? -add SALT/VINEGAR? -RINSE eggs until cool IMMEDIATELY after cooking?

Questions #1-4 involved studying physical aspects of the shell - inconsistency, layers, a somewhat porous nature, and susceptibility to cracking. The name "Hard Cooking" came from Question #3, (eggs should be simmered, not boiled. Thus, "hard-cooked," not "hard-boiled.") Starting with eggs at ROOM TEMPERATURE, COLD WATER, and SIMMERING, lets the shell gradually expand, causes less bombardments of water molecules on the shell, thus decreasing chance shell crackings. POKING A HOLE in the large-end pierces an air cell, giving more room for egg white expansion.

Questions #5,6 dealt with the chemical make-up of eggwhite-including staining for protein, finding protein structure/composition; and finding composition/staining yolk for elements. From salt added to water: $H_{(aq)} + Cl_{(aq)}$ --> HCl; From vinegar: Acetic Acid. If the shell cracked, weak acid would oxidize the protein's molecular bonds, letting them stringout to others, cooking eggwhite on the spot.

"Dreaded Green Yolk" - green film that forms on yolk UNPREDICTABLY

Cause: $H_2S_{(g)} + Fe_{(s)}$ --> $FeS_{(s)} + H_{2(g)}$
(Decomp. protein)+(Fe in yolk)--> (green) + (released)

Solution: Heat travels hot-->cold. $H_2S_{(g)}$ goes to the coolest part, the yolk. If the shell's made coolest via COLD WATER RINSE, the $H_2S_{(g)}$ goes out to the shell, not into the yolk, thus avoiding the "DREADED GREEN YOLK." This brief overview helps show how to cook better hard-cooked eggs, and describes the chemistry behind "hard cooking."

THE ISOLATION AND IDENTIFICATION OF SPINOCHROMES FOUND IN ECHINODERMS

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In the past decade some work has been done involving pigments from marine animals. One type of pigment that has received some attention is that isolated from the Echinodermata. These pigments have the basic hydroxynaphthoquinone structures, the juglone or the naphthazarine, and are commonly called spinochromes. A,B,C,D, & E. In my experiment, I tried to isolate and identify the spinochromes of different echinoderms.

The sea urchin is the best candidate for an experiment with spinochromes. I isolated the spinochromes by placing sea urchin spines into concentrated hydrochloric acid. After the spines were digested, a red pigment remained. Next, this red pigment had to be purified by removing the lipids and fatty acids contained in it. This was done by a complex process of filtering, changing the ph, and ether washing. The spinochromes would be isolated in the final ether washing stage.

Next, the spinochromes had to be identified. This was done by breaking down the pigment by both column and this layer chromatography. The fractions were then identified by using NMR and a Mass Spectrometer. The sea urchin spines in my experiment contained spinochromes B and E. Out of the other Echinoderms tested, only the sand dollar had spinochromes; the starfish, brittle star, and sea cucumber did not.

Organic pigments can be used for dyes, perfumes, and medicines. Recently, organic pigments have been used in cancer research. Perhaps, spinochromes can be used for these practical purposes.

OXIDATIVE STRESS IN LIVER DUE TO ACUTE ETHANOL INGESTION

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To investigate the hypothesis that the metabolism of ethanol through the xanthine oxidase pathway plays an important role in the production of active oxygen species causing oxidative stress in animals treated with ethanol (5 g/kg b.w.), I assayed the amount of the total sulfhydryl content in the liver. The decrease of total sulfhydryl content is a good indicator for oxidative stress in the cell. When rats were treated with the xanthine oxidase inhibitor allopurinol in conjunction with ethanol, the production of active oxygen species was blocked and a significant increase in total sulfhydryl content was observed. This indicated that the products of the reaction between xanthine oxidase and acetaldehyde, namely hydrogen peroxide and superoxide, caused a conversion of the sulfhydryls to disulfides. Conversely the rats treated with 3-amino-1,2,4-triazole, a catalase inhibitor, in conjunction with ethanol, produced a significant decrease in the total sulfhydryl content. Catalase a protective enzyme, scavenges excess hydrogen peroxide, and its inhibition caused a build up of the oxidant producing an oxidative stress in the cell.

The role of the active oxygen species produced through the xanthine oxidase pathway in acute ethanol toxicity appears to be the production of oxidative stress in the liver. This stress can further lead to the production of liver damage and disease. The exact part the active oxygen species play in liver disease and damage is not fully known, but the recognition of their existance in ethanol metabolism opens the door for further study in the etiology of ethanol metabolism.

A BIOCHEMICAL ASSAY OF TRIGLYCERIDE PHOSPHOLIPID RELATIONSHIPS

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By varying the chemical environment of maturing plant cells grown *in Vitro*, it will be determined if there is a quantitative relationship between triglyceride (fat) and phospholipids (lecithin) synthesized by the cells. The primary factor that influences fat and lecihtin production in plant cells if the plant's ability to synthesize them from phosphatydic acid.

In order to test the possibility of a definite relationship of the amount of fat to the amount of lecithin, *Duacus carotus* cells were grown *in Vitro*. By growing the cells in this fashion the experimenter has the ability to remove certain variables that he would be unable to remove in nature.

It was determined that there is not a positive, quantitative relationship between the amount of triglyceride (fat) and phospholipids (lecithin) as these compounds are synthesized by maturing *Duacus carotus* cells grown *in Vitro*. However, it was concluded that by varying the cell environment in the fashion, this does directly affect the amounts of fat and lecithin produced by the maturing *Duacus carotus* cell.

*NEUROLEPTIC ANTAGONIST INTERACTIONS WITH THE D-2 RECEPTOR

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The molecular mechanism of binding of the neuroleptic antagonist, ^{3}H-spiperone, to the D-2 receptor in rat caudate preparations was investigated through radioligand binding studies. The kinetics of antagonist dissociation, following 20min of incubation, yielded evidence for two kinetic components, a fast phase(65%) and a slow phase(35%). After prolonged incubation of 60min, the fraction of the slowly reversible high-affinity component increased to 69%. These results indicate that there exist two interconvertible low and high affinity conformations of the D-2 receptor. When the antagonist ligand binds to the low-affinity conformation, a rapidly reversible complex is initially formed. After additional incubation, this complex is transformed to a slowly reversible, high-affinity complex. This time dependent conversion involves a conformational change in the low-affinity state of the D-2 receptor induced by the binding of the antagonist ligand. Sodium ions appear to facilitate this conversion of the D-2 receptor from the low affinity antagonist state to the high-affinity antagonist state. This model may be further expanded to accommodate the ternary complex model and to support the reciprocal model for the D-2 dopamine receptor. This study attempts to provide a better insight into the molecular mechanism of action of neuroleptic drugs.

*First Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society
Fourth Award - General Motors ISEF

THE EFFECTS OF TAPER TRAINING ON MUSCLE GLYCOGEN LEVELS

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Taper training is a period of training usually lasting two to three weeks immediately preceding the championship meet in which a severe reduction of yardage takes place. This study concentrated upon the consequences of such a training program on the levels of muscle glycogen in slow twitch fibers. Muscle glycogen increases significantly in regularly exercised animals.

Twenty-four mice were divided into four groups of six : I) Rest Control,II) Running Control,III) 7-Day Taper,IV) 14-Day Taper. Each group trained one hour on a motor driven treadmill for eight weeks. They then diversified into their training programs with the taper groups eventually reaching 15 minutes of training.

After sacrifice and analysis by PAS technique, glycogen content was determined as light, moderate, of dark. The glycogen content of trained mice (groups II, III, IV) was significantly higher than that of the rest control. Taper trained mice showed no difference in muscle glycogen content as compared to the running control.

In conclusion, the taper effect can be defined as a gross reduction in exercise stimulus without loss of muscle glycogen levels.

CHROMATOGRAPHIC DETERMINATION OF PTERIDINES IN THE EYES OF *DROSOPHILA MELANOGASTER*: COMPARATIVE STUDY OF SPECIES

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Pteridines are organic compounds commonly found in the eyes of arthropods. *Drosophila melanogaster* is an arthropod usually used in genetic laboratories. The pteridines found in the eyes of *D. melanogaster* according to their classification are: *Drosopterins* (orange), Isoxanthopterin (violet-blue), Xanthopterin (green-blue), Sepiapterin (yellow), 2-Amino-4- Hydroxypteridine (blue), Biopterin (blue) and Isosepiapterin (yellow).

In this work I attempted to determine the pteridines present in the eyes of different species of *Drosophila* (*D. mojavensis*, *D. virilis*, Oregon Rt Canton 5, Oregon R, Canton 5 and the Wild Type) through paper chromatography using a mixture of propanol and ammonia (2:1) as the solvent. Some mutations were studied in the body of the different species of *Drosophila* to compare changes in distinct parts of the body (antenna, eyes, thorax, wings, abdomen and genital plate).

It was shown that the pigments that could not be identified in the others species of *Drosophila*, that were not *D. melanogaster*, was due to the fact that they did not exhibit the same sequence of pteridines shown by *D. melanogaster*. There was a variation in the sequence of pteridines between males and females of the experimental species.

It was also shown that more mutations are found in the wild type probably due to the place where they are found. Most mutations were found in the wings, abdomen and genital plate.

# UNEXPECTED EFFECTS OF ULTRAVIOLET RADIATION, A MAJOR ENVIRONMENTAL CARCINOGEN, ON HUMAN CELLS.

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The synthesis of U1 and other small nuclear RNAs (snRNAs) (RNAs needed for messenger RNA maturation) shows two paradoxical phenomena after UV irradiation: an immediate inhibition and a delayed inhibition (this late inhibition requires about two hours of postirradiation cell incubation and much lower UV doses). The first question asked in this project was whether the early and the late inhibitions are separate reactions (i.e., whether there is early inhibition in the absence of postirradiation incubation). HeLa cells were UV-irradiated and then labeled for 1 min after 0 to 9 min of postirradiation incubation. The data extrapolated to a marked suppression of U1 RNA synthesis at 0 min of postirradiation incubation, indicating that there was inhibition in the absence of postirradiation incubation (therefore, the early and late inhibitions are separate reactions). After 10 min of postirradiation incubation most of the synthesis of U1 RNA is known to be inhibited by UV light, but a small subpopulation is UV-resistant. After 130 min of postirradiation incubation, U1 RNA synthesis is inhibited at a faster rate and the UV-resistant subpopulation disappears. The next question was whether any of these two transitions was gradual or showed a threshold. Results from a series of 2-min radioactive pulses show that both the increased rate of inhibition of U1 RNA synthesis and the disappearance of UV-resistant U1 RNA synthesis change gradually between 10 and 140 min of postirradiation incubation. These observations have not been made before in these or any other type of cells, and will be submitted for publication soon.

#Fourth Award - General Motors ISEF

SEPARATION OF BLOOD SERUMS AND HEMOGLOBIN BY ELECTROPHORESIS

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The purpose of this project is to separate and compare blood serums and hemoglobin in order to detect diseases and abnormalities. All red blood cells contain hemoglobin, which is a globular protein made up of four subunits and each subunit contains a polypeptide chain attached to an iron containing compound called heme. The function of these molecules is to transport oxygen to the tissues. A lowering in the amount of hemoglobin in the blood can cause anemia. In this condition, the red blood cells are deoxygenated and they crystallize in the blood. This leads to a distortion of the cells into a sickle shape. The abnormal cells are then rapidly destroyed by the immune system.

Whole blood is made up of two major fractions: plasma and serum. Serum is the straw colored fluid that is left when the blood clots and is centrifuged down. It has basically the same composition as plasma except for some clotting factors. Serum has two major fractions: albumins and globulins. The albumins make up 3.5-4.5g/100mL of blood. Separation of serum is used for the detection of diseases and has been used extensively in the clinical laboratory.

The separation of the molecules is done by agarose gel electrophoresis. Electrophoresis is the movement of charged molecules by net charge, size, or shape. Samples are loaded into wells of an agarose gel and are submerged in a buffer solution to prevent heat buildup during electrophoresis. During electrophoresis, proteins are separated out of serums by their net charge which is determined by their isoelectric point. All the experiments carried out worked as they should have and the samples could be compared with the known values of the type of sample tested.

#ENZYME BIOTECHNOLOGY: A NOVEL APPROACH TO ENZYME REJUVENATION

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Immobilized glucose isomerase is used in the manufacturing of High Fructose Corn Syrup (H.F.C.S.), a sweetener for soft drinks and many foods. The enzyme ages (loses activity) after a few weeks' use and is costly. Hence, a method of rejuvenating (reactivating) the enzyme would greatly reduce the costs of H.F.C.S. production.

A novel approach consisting of first unfolding the aged enzyme to a random-coiled chain, and then refolding it back to its native active form has been proposed and successfully attempted. Preliminary results show that significant rejuvenation of the aged enzyme to approximately 2/3 and 3/4 of the native activity enzyme has been achieved.

Aside from its economic potential, the successful rejuvenation suggests enzyme aging may result from a conformational change to an inactive form which can then be refolded to its native conformation by first unfolding it into a random-coiled chain.

#First Award - American Medical Association
Fourth Award - General Motors ISEF

ESTABLISHING THE ESSENTIAL ROLE OF THE NEUROTRANSMITTER 5-HYDROXYTRYPTAMINE IN AGGRESSIVE AND DOMINEERING BEHAVIOR

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Past research has led to the hypothesis that many basic drives and emotions are governed at least in part by the balance or imbalance of certain neurotransmitters in the brain. The purpose of this project was to show, through experimentation, that aggression and domineering behaviors characteristic of the establishment of dominance among animals correlate to a deficiency of 5-hydroxytryptamine. It will further attempt to relate this data to previous research in an effort to satisfy the criteria necessary to establish the critical role of 5-HT in mediating aggression. Ten rats will be divided into groups of 1,2, and 3 members and dominating and submissive behaviors will be noted. Each rat was then paired against members of different groups and the dominant rats were again noted. Levels of [illegible] 5-hydroxytryptamine in each rat were quantified through column chromatography and spectrophotometry. This data allowed the detections of a relationship between 5-HT concentrations and aggressiveness. There was an 85% correlation between data sets. This is sufficient to allow accurate predictions of the aggressiveness of any individual rat. Future uses include the diagnosing of violent and aggressive people with direct applications for the armed forces and mental institutions.

USAGE OF MARIGOLD AND LIMONIN AS NATURAL INSECTICIDES AGAINST MEALWORMS AND HOUSE CRICKETS

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Purpose: Is to test a safe, natural insecticide on insects and also to test the insecticide as a bactericidal agent.
Procedure: I selected marigold vines and citrus fruit peelings for my natural insecticide. I weighed 50g of citrus fruit peelings and marigold vines and added 100ml distilled water or alcohol and blended. Let stand (24 hr.), then strained the mixtures. Prepared the store products by mixing 25ml of the product to 75ml distilled water. Selected crickets and mealworms and fruit flies. Chose a dosage. I used three different dosages for the crickets and meal worms. I used drops for the crickets and mealworms to be certain of the amount being applied, and one full spray for the fruit flies because they were hard to contain. I timed them from contact to death. I also did sensitivity testing using the Kirby Bauer method to see if the insecticides could be used as a bactericidal agent. Then I ranked them according to the zone of inhibition.
Conclusion: I found that as an insecticidal agent, Red Spider #1 store product, marigold/alcohol #1 natural insecticide, and over all marigold and alcohol. As for bactericidal agents, Team #1 store product, marigold/alcohol #1 natural insecticide and over all again marigold/alcohol.
All and all I would recommend you to use Red Spider (#1 store product), I also think that in the future the extracted oils from citrus fruits and marigolds could be used as a safe, natural insecticide.

EFFECTS OF SARSAPONIN ON THE HIND GUT PROTOZOANS OF *RETICULITERMES FLAVIPIS*

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In this experiment, the plant steroid Sarsaponin was introduced into a culture of microorganisms from the hind gut of the termite *reticulitermes flavipis*. This was done to determine the effect of Sarsaponin on the growth and reproduction of symbiotic protozoans. Sarsaponin is currently used commercially to promote growth in cattle cilliates. The experimental cultures were created by placing a crushed termite in a culture medium containing 50 grams of ground cellulose, a small amount of nutrient agar and a balanced salt solution. Sarsaponin was introduced into half of these cultures at a rate of forty parts per million. Several control cultures were also established. Because protozoan populations were low during the first several weeks, the protozoan activity was measured in terms of the amount of gas collected in the culture tube. When the culture is further developed, a counting chamber will be used to count the number of protozoans in a given sample. Early results have shown a slightly higher amount of gas produced in those cultures containing Sarsaponin.

MICROBIAL DEGRADATION OF KERATIN FROM *Gallus domesticus* (CHICKEN) FEATHERS

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Keratin, a fibrous, insoluble protein, is the component of feathers. No single enzyme has been isolated for the hydrolysis of this protein. This project had devised a medium, made up of a suspension of ground feathers in water, for the incubation of strains of *Streptomyces* can indeed liberate free amino acids from keratin. However, the autoclaving of the cultures to kill the live organisms recoagulated the free amino acids into a new protein. Since keratin is a very complex protein, random attachments among amino acids under heat cannot reform the fibrous keratin, but a globular, hence digestible, protein. The nutritive content of this protein shows great promise as a poultry feed.

More research is recommended in this little investigated field.

#First Award - American Veterinary Medical Association
Third Award - General Motors ISEF

LYSOPHOSPHOLIPASE ACTIVITY OF *MYCOBACTERIUM SMEGMATIS*

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Lysophospholipase(LPL) activity found in *Mycobacterium smegmatis* was characterized. LPL activity was measured through titration of the fatty acids hydrolyzed by the enzyme. The five individual experiments indicated that lysophospholipase activity of *M. smegmatis* was highest when four to ten-day-old cultures were tested; between 37° and 60°C; between a pH of 6.0 and 10.0; at a concentration of 4.5×10^9 viable bacteria/ml of glycerol solution; and, after twelve hours of assay incubation. This study is significant because it represents basic scientific research. It also acts as a nonpathogenic model for a similar study on *Mycobacterium tuberculosis* which could potentially function as a more accurate diagnosis than present means.

AN EXAMINATION OF THE PERFORMANCE OF GLYCEROL AND DIMETHYLSULFOXIDE IN THE FREEZING OF BOVINE ERYTHROCYTES

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The cryopreservation of erythrocytes requires an ordered procedure for the protection of individual cells, primarily from damage due to intracellular ice. Each combination of freezing curve and final temperature requires a different method of protection, often consisting of the utilization of varying concentrations of cryoprotectants, chemicals used to protect specimens from freezing injury. Slow freezing, which causes the formation of large intracellular ice crystals, poses special problems. This experiment was designed to test 2 prominent cryoprotectants, Glycerol and DMSO, for their ability to protect bovine erythrocytes when frozen at a slow freezing curve to a relatively high sub-zero temp. Blood, centrifuged to remove plasma, was added to 2.5%, 5%, 10%, 15%, 20%, 25%, 30% and 35% concentrations of cryoprotectant in phosphate-buffered saline. The blood solutions were then frozen at a rate of -1°C/min. to -7°C, held for seeding, and brought down at -.7°C/min. to a final temp. of -30°C. Samples were then thawed and tested for viability. The 25% DMSO solution achieved the best viability rating of 74%, confirmed by a statistical t-test. Thus 25% DMSO, due largely to its superior penetrating power and miscibility in salt solutions, such as blood and phosphate-buffered saline, proved most successful. This information will aid in the development of new cryoprotection methods dealing with the problems of slow freezing.

DOES ACETYLSALICYLIC ACID AFFECT ASCORBIC ACID CONCENTRATION?

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This work was done because of an interest in optimum health and acetylsalicylic acid (aspirin) and ascorbic acid (vitamin C) are common substances in the body. The hypothesis is that vitamin C concentrations decrease when aspirin is present. Seven concentrations of vitamin C and five concentrations of aspirin were added individually to test tubes. A dinitrophenylhydrazine-thiorea-copper sulfate reagent was added to all tubes. They were incubated for three hours, chilled, and sulfuric acid was added. The tubes were read in a spectrophotometer (spec 20) at 540 nanometers. Metaphosphoric acid was used as the blank because it was the solvent in the vitamin C solutions and it was centrifuged with the plasma. This procedure was repeated with plasma added, but only extreme concentrations of the vitamin C and aspirin were used. The spec 20 absorbance and per cent transmittance values are related to concentration through the Beer's-Lambert law. The lower the per cent transmittance, the lower the concentrations of the solutions. For the non-plasma, the % transmittance decreased as the aspirin amount increased for a single vitamin C concentration, but only up to a certain point of saturation, natural spec curve, or disregard to Beer's law. In plasma, as to simulate the human body more, the % transmittance decreased with aspirin added, although the amount of aspirin made no difference. This means that a person who takes aspirin should consume extra vitamin C to get the daily requirement.

THE SYNTHESIS, PURIFICATION, CHARACTERIZATION, AND IMMUNOGENIC STUDY OF PEPTIDE HISTIDINE ISOLEUCINE

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Peptide Histidine Isoleucine (PHI) is a gastric regulatory peptide that was isolated in porcine intestine by Swedish scientists in 1984. The release of PHI from the brain induces the relaxation of the gall bladder and other smooth muscle, the secretion of digestive juices in the stomach and small intestine, and the production of insulin in the pancreas. These characteristics of PHI have attracted a great deal of interest from gastroenterologists.

The major problem in performing research on PHI is that no biochemical companies or institutions in the world produce this peptide for distribution to laboratories. This experiment required the synthesis of PHI in the lab. The peptide was purified by high pressure liquid chromatography, and its biochemical characteristics were studied. A procedure using liquid chromatography and amino acid analyses was developed to produce pure PHI.

The purified PHI was iodinated; attached to a radioactive iodine isotope so that it may be traced in an organism. A procedure was developed to prepare PHI for antibody experimentation as well. The products of this experiment were sent to a gastroenterologist at Harvard University to be used in various studies of PHI function.

BOTANY

PLANT SYSTEMATICS...A NUMERICAL APPROACH TO THE TAXONOMY OF 200 COMMON OKLAHOMA WILDFLOWERS

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The purpose of this project is to show natural relationships among angiosperms by using a numerical system of taxonomy. This was done by taking 22 identical characteristics from each wildflower and assigning a number to those characteristics. These numbers were totaled and multiplied by 100 to give the family number for each plant. A distinguishing number was found by taking the number of the plant, dividing by 200 and then multiplying it by 100. This formed the genus number. This number was then added to the family number. The species total for each plant was then formed.

The key was written to classify all of the plants down to their family, genus, and species totals. The main key at the beginning leads you through a series of steps until you reach the family number. From that point, turn to the key to the genera and species, to find the family number. This will then break the family down to the genera and finally to the species.

In conclusion, no one system of taxonomy is perfect, but is designed to show natural relationships among different organisms. The numeric system, although not perfect, has proven to be just another possible tool in accomplishing the task of classifying organisms into their natural groupings.

DOES THE COMBINATION OF A MAGNETIC FIELD AND IRON WATER AFFECT THE BIOLOGICAL PROCESSES OF A PLANT?

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My experiment is a continuation of previous science fair projects performed over the last three years. My original objective was to see if a magnetic field had any effect on seed germination. Although no effect on germination was recorded, the magnetic field seemed to enhance the growth of the plants. Experiments since then have lead me to believe that the growth differences recorded had some relationship to the chemical make-up of the water in conjunction with the magnetic field.

In this year's experiment, I am testing to see if different concentrations of iron water have different effects on plants in the presence of a magnetic field. Results seemed to show evidence of enhanced color and plant growth when using the magnets and the isolated iron solutions. I have come to the conclusion that the more iron present, the greater the benefit derived from the magnetic field. This is shown by the higher standard deviation when comparing the average measurements of the groups watered with the higher iron concentration.

If my conclusion can be further tested with validity, it is possible that it could have potential benefit to the agricultural community in the future.

#THE EFFECT OF IONIZING RADIATION (IN THE FORM OF GAMMA AND X-RAYS) ON THE OVERALL DEVELOPMENT OF WHEAT, BEANS, PEAS, AND RADISHES.

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In the following experiments, seeds were exposed to different levels of gamma rays and x-rays in order to increase the frequency of mutations. Data was gathered to determine which plants had desirable mutations. Seeds were collected from these plants and were replanted through several generations. The results of the four experiments were small crops of new plant varieties with improved qualities.

Wheat was exposed to 500, 1000, 2000, 3000, and 6000 rads of cobalt 60 gamma radiation in the first experiment. Improved plant varieties (produced at the levels of 500, 1000, and 2000 rads) showed the qualities of sooner plant maturity, increased height, and increased weight of the seed produced.

Beans were exposed to 100, 250, 500, 1000, and 2000 rads of cobalt 60 gamma radiation in the second experiment. Improved plant varieties (produced at the levels of 500 and 1000 rads) showed the qualities of sooner plant maturity, increased height, increased height of primary leaves, increased height at which seed was produced, and increased weight of the seed produced.

Peas were exposed to 50, 100, 150, 200, 250, and 300 rads of x-ray radiation in the third experiment. Improved plant varieties (produced at the levels of 250 and 300 rads) showed the qualities of sooner plant maturity, increased height, increased height of primary leaves, increased height at which seed was produced, and increased weight of the seed produced.

Radishes were exposed to 50, 100, 150, 200, 250, and 300 rads of x-ray radiation in the fourth experiment. An improved plant variety (produced at 200 rads) showed the qualities of sooner plant maturity, increased height, and increased weight of the seed produced.

#Second Award - United States Air Force
Third Award - General Motors ISEF

#THE IMPACT OF NITROGEN MANAGEMENT PRACTICES ON CORN PRODUCTION AND THE POTENTIAL FOR GROUNDWATER CONTAMINATION

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The purpose of my project was to determine how different rates of Nitrogen (N) fertilizer applied to the soil affects the corn yield, percent grain protein, and nitrate-nitrogen remaining in the soil for irrigated corn. The purpose of the groundwater study was to determine if any extensive areas of nitrate contamination were present in rural domestic water supplies.

There was a total of 28 plots selected on our farm. Four replications of the following treatments were applied: 0, 50, 100, 150, 50 split 3 times, 200,and 250. The plot arrangement was randomized and the dimensions were 50' x 15'.

Nitrate-nitrogen content of soil, percent grain protein (total Kjeldahl nitrogen) levels, and percent leaf N were tested at the end of the crop year. The analyses,which involved the use of laboratory equipment, were performed by myself at Keim Hall, University of Nebraska, Lincoln, under the direction of James Schepers. For the water quality tests, a total of 262 wells were tested by collecting water over a six-year period using a spectrophometer which utilizes colorimetric analysis to determine the nitrate-nitrogen content.

It was concluded that the larger quantities of N applied to the soil were not utilized to increase yield or the percent protein of the corn. It can also be concluded that there was a definite increase in nitrate-nitrogen levels in the water at some areas.

Statistical analysis was conducted to test the hypothesis and assist in developing experimental conclusions.

#First Award - American Society of Agronomy
First Award - General Motors ISEF
First Award - United States Air Force
Second Award - Sigma Xi, the Scientific Research Society

Research and development of a new method of sod production - "Hydroturf"

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The development of a new technique for the production of sod in greenhouses could represent a revolution in the agricultural industry. The new sod, "Hydroturf," is ready for harvest in less than a week and can be produced year-around with much less expense.

Along with refining production techniques for "Hydroturf," my project also compared this new product with conventional sod. In field tests, "Hydroturf" proved to be superior to conventional sod in ease of handling, heat tolerance, storage, lawn establishment, etc. "Hydroturf" was also found to be superior in a cost/profit analysis. Not only can it be produced with a minimal amount of labor, but production in a controlled environment eliminates the need for herbicides, insecticides, elaborate irrigation systems, and large plots of land.

Of the plant growth hormones known to effect monocots, Gibberellic Acid proved to be a good choice if applied after germination. Presoaking seeds was also found to be effective in reducing harvest time.

# EFFECTS OF THE PLANT HORMONE N-6 BENZYLADENINE ON BEAN PLANTS AND DIFFERENTIAL GRASSHOPPERS

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PURPOSE: To find out what effects N-6 Benzyladenine has at various concentrations on beans and the effects it has on grasshoppers.
PROCEDURES: 1) Add hormone solution to growing plants; 2) Measure growth of leaves and stem; 3) Spray leaves of a new set of plants and test effect the hormone has upon them; 4) Feed grasshoppers the hormone solution through plants; 5) Check outward changes in grasshoppers; and 6) Check internal changes in grasshoppers by dissection and microscope viewing.
PRINCIPAL FINDINGS: 1) In plants from 1/4mg to 1mg per liter of hormone caused growth above normal, from 5mg to 30mg per liter of hormone caused dwarfism; 2) Cell number increased, size decreased in beans; 3) Plants grew in cycles, rapid growth to decreasing growth; 4) More branches and leaves occurred on plants treated with 1/4mg to 1mg per liter of solution; 5) Plants had fewer and deformed leaves at concentrations from 5mg to 30mg per liter; 6) 75% of grasshoppers died when exposed to treated plants and had smaller but more cells than normal grasshoppers; 7) Treated plants had greener leaves than normal plants; 8) The nymph stages were retarded; and 9) Deformities occurred when grasshoppers were molting.
CONCLUSION: If this hormone was used commercially at the right concentration crop yield would increase; however, plant mutations would occur. Also from the results I got with the grasshoppers, mutations in the insects that eat the plants would occur maybe causing things far worse than what the increased crop production would yield. Also, soil nutrients would probably decrease rapidly due to the faster growing plants.

#First Award - United States Navy/Office of Naval Research
Fourth Award - General Motors ISEF

SALT TOLERANCE IN AGRICULTURAL CROP SPECIES

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Millions of acres of land throughout the world are too saline to produce economic crop yields. Generally, plant species differ in their tolerance to total salts and to specific ions. Some agricultural crop species have been tested for salt tolerance. But new varieties of crop seeds are being developed and testing for salinity tolerance is not always done. The purpose of my research was to study different varieties of selected crop species for salt tolerance.

Tests were run using alfalfa, mustard, triticale, oats, four varieties of wheat, four varieties of corn and five varieties of barley. Germination experiments were run at different concentrations on all seeds with solutions of artificial seawater. The main salt components of seawater; sodium, calcium, potassium and magnesium (in the chloride form), were also checked against germination rates. Studies were conducted with selected seedlings to determine the effect of salinity on plant growth rates and root formation. Leaf chlorophyll response to salinity was also measured.

There were measurable plant responses to seawater, even among varieties of one species. There was also variation in reaction to specific salts, indicating interactions between the salts when in conjunction with one another.

EXPLORING THE NITROGEN-POTASH RELATIONSHIP IN CORN

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PURPOSE: The purposes of my project are 1) to find the most economical rates and ratios of nitrogen and potassium for corn under actual field conditions; 2) to study the vascular and supportive tissues in the stalk to find a possible correlation to nitrogen and potassium; and 3) to study the concentration of nutrients and rind thickness in the stalk to determine storage characteristics related to yield and standability.
PROCEDURE: I grew eleven acres of corn with two genotypes and fifteen different fertilizer rates. Stalk sections were collected during the growing season and were analyzed for nutrient concentration. Vascular tissue in the stems of the corn plants were evaluated to look for differences related to fertilizer and yield. Statistical analysis was run on yield, returns, nutrient concentration, and rind thickness.
CONCLUSIONS: 1a) Higher rates of potassium were economical to apply, and 360 lbs. of potassium (K)/Acre was the most economical rate of K this year. 1b) A rate of nitrogen (N) of 120 lbs./A was the most economical of the nitrogen rates. 2) Vascular bundle area decreased as K rates increased. 3a) Carbohydrate concentration in the stalk was reduced as K rates increased. 3b) Rind thickness in the stalk decreased as K rates increased. 3c) Potassium concentration in the stalk increased as K rates increased. 3d) It seems that as yields increase, stalk quality decreases. From three years of data it appears that a rate of nitrogen in the range of 120 lbs./A is the most economical, and it appears economically feasible to apply potassium at levels at or exceeding 240 lbs./A.

#First Award - United States Army
Third Award - General Motors ISEF

NEW LIQUID CULTURE MEDIA FOR CELLULAR PROPAGATION OF CAPSICUM CUBANELLE

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In this investigation we have developed three methods of liquid cultivation (A, B, C), that produce cellular division with marrow cells of Capsicum cubanelle. The method of liquid cultivation was prepared modificating the Murashige multiplication method from the agar and auxins remotion and the addition of the citokinines in different concentrations and proportions.

All the methods were submitted to an energetic cycle of 16 hours light and 8 hours dark and backwards, also at temperature of 25°C and a pH of 6.5 and 6.8.

The concentration of cells were measured using a Bouech and Lomb 70 spectronic. We discovered that the biggest production of cells (89.0%) were found in the middle of the liquid cultivation C under dark physical conditions, with a pH of 6.8 and a 25°C temperature.

We found that the mathematics proportion between auxins and citokinines is the stimulation factor that accelerates cellular division in the medium cultivation.

Based upon the results of liquid multiplication of cellular medias, three solid media cultives (A, B, C) were made which produced the growth of an indifferent mass of cells (callus). The physical factors of light, pH and temperatures were controlled. It was found that a reduction in the nutrients and vitamins of media cultures A-C plus the addition of auxins and vitamins, and the elimination of citokinines produced a bigger, better and faster production of callus.

A DETERMINATION OF THE INTERACTION OF THE CYTOKININ, KINETIN, WITH THE AUXINS, INDOLEACETIC ACID AND BENZYLADENINE ON LYCOPERSICON ROOT DEVELOPMENT

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The purpose of my project was to find the effects that varying concentrations of the auxins, Indoleacetic Acid and Benzyladenine, and the cytokinin, Kinetin, have on Lycopersicon root development grown in White's Salt Base Tissue Culture Media.

The first procedure taken was to clean the seeds of surface contaminants. This was done by placing the Lycopersicon (tomato) seeds in 10% Sodium Hypochlorite for 20 minutes. After 20 minutes, the Sodium Hypochlorite was drained and replaced with sterile distilled water. The seeds were then refrigerated for 24 hours. The seeds were then placed on sterile agar to germinate to a length of 25mm.

.025%, .050%, and .100% concentrations were prepared using each of the three hormones and a mixture of Indoleacetic acid and Kinetin. Each concentration was prepared using White's Salt Base Tissue Culture Media. The concentrations were autoclaved for 25 minutes at 15 p.s.i. Each concentration was divided into four cultures.

Within a laminar flow unit, a root is taken from the agar and 10mm of root cap is excised and placed into each culture tube. Three controls were also prepared.

The cultures were monitered, and the length of the root in each culture was recorded daily. The roots were subcultured every two weeks.

The roots in the pure cultures had lengths of 16-25mm and had several secondary roots. The .050% and .100% concentrations of the auxins came closest to the lengths of the controls with average lengths of 16mm but produced no secondary roots.

My conclusion is that the .050% and .100% concentrations of the auxins produce the longest length but hinder the ability of the root to produce secondary roots which is a significant part of root development.

THE EFFECTS OF SULFUR DIOXIDE ON GERMINATION

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The purpose of this project was to determine the effects of sulfur dioxide on germination. 120 beans were germinated in different environmental categories: Normal ((N)-SO_2), Very Low ((VL)-SO_2), Low ((L)-SO_2), Moderate ((M)-SO_2), High ((H)-SO_2), and Very High ((VH)-SO_2). They were placed on moistened paper towels and were submitted to different amounts of SO_2, depending upon the category. The air was then circulated and the containers mostly freed of SO_2. Seedling length was measured daily.

60 more beans were planted in soil and grouped into the same categories as above. The experiment was conducted in the same manner, except soil was used in the place of the paper towels. The length of the seedling is not measured;however, the germination rate was observed.

According to the results of this experimentation it is concluded that as the amount of SO_2 increased, the germination rate decreased. There was not as much effect noted in those beans germinated in soil as those germinated without soil. Therefore, it could be concluded that contact with SO_2 has an affect on germinating bean seedlings.

# ANATOMICAL MORPHOSIS

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Normally an ornamental ground cover, Joy weed (*Alternanthera amoena*) is sometimes seen in pet stores as an aquarium plant. This prompted research on "Anatomical Morphosis" or the development of form, to prove that Joy weed has within its range of adaptations the capacity to survive under aquatic conditions for a long period of time.

Fifty cuttings of Joy weed were started. The control (terrestrial) set remained in its natural environment, whereas the experimental (aquatic) set was raised underwater in an aquarium. Data were collected after eight and sixteen weeks and analyzed.

Eight parameters were studied: 1) stomatal distribution; 2)plant growth; 3) stomata size; 4) leaf area and dimensions; 5) rigidity of plant; 6) stem circumference; 7) root distribution and 8) pigment or light absorption differences between aquatic versus terrestrial *A. amoena* were abserved and measured.

Significant differences were found in all of the parameters.

1) Greater stomatal distribution in aquatic Joy weed.
2) Greater plant growth in terrestrial Joy weed.
3) Length of stomata was greater in terrestrial Joy weed, whereas the width was greater in aquatic Joy weed.
4) Leaf surface area was greater in aquatic Joy weed. Also, the length of leaves was greater in aquatic Joy weed, whereas the width of leaves was greater in terrestrial Joy weed.
5) Terrestrial Joy weed was more structurally rigid.
6) Stem circumference of terrestrial and aquatic Joy weed were equal.
7) Root distribution was greater in aquatic Joy weed.
8) Pigment extracts of aquatic Joy weed absorbed more light.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent Trademark Office Society
Third Award - General Motors ISEF

A NATURAL GROWTH STIMULANT OF WHEAT

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The purpose of my project was to learn if a natural stimulant could be extracted from the seed of wheat and then to measure its effect on the growth rate of seedlings from various wheat varieties. I experimented with both spring and winter varieties of wheat and researched the stimulant's influence in solid as well as liquid form. The solid form was prepared from wheat seeds ground up in a blender, while the liquid was obtained by soaking wheat seeds in water to form a concentrated extract of the stimulant. My first experiments were done with the solid form of the growth stimulant. The powder, of the ground wheat seed, was placed along side the planted seeds of the variety of wheat to be tested. I experimented with concentrations of the stimulant ranging from one-tenth of a gram to one gram. They were compared to control seedlings, those that received just water, and to plants that were given a 5-10-5 fertilizer solution. I learned that a one-tenth gram concentration of the powder promoted better growth than either the control or the fertilizer solution. Next, I experimented with liquid solutions varying from one to five percent concentrations of the natural growth stimulant. My experiments proved that one and two percent concentrations were the best in stimulating seedling growth as compared to plants that received the fertilizer solution or the control plants. These plants grew faster, had higher germination rates and greater secondary leaf development.

EFFECTS OF EXTRACTS OF *LANTANA CAMARA* L. ON FOUR DIFFERENT TYPES OF SEEDS.

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L. camara or milk weed is a weed found in Puerto Rico with a disagreable odor, known for its ability to supress other weeds. Release of toxic metabolites by plants, allelopathy, is a weed suppression mechanism. This investigation is an attempt to determine the effects of this plant on the germination of seeds of *Phaseolus vulgaris*, *Lactuca sativa*, *Brassica oleracea* and *Lycopersicum esculentum*.

Five percent extracts were applied to 25 seeds of each type in Petri plates. Seeds were kept moist with extract except for the control. Germination was compared against control. Growth of epicotyl was measured and searched for anomalies. Results showed effect on germination and growth of all seedlings.

Leaf, stem and root extracts were used to determine which part of plant contains highest concentration of toxic substances. *P. vulgaris* and *L. esculentum* seeds were used. Each extract was prepared in concentrations of 5%, 25%, 50% and 75%. Germination, length, number of leaves, of nodes and distance between nodes were recorded for 30 days. Leaf extracts produced highest inhibition. Concentration did not determine germination percentage. Length and number of leaves were affected, the higher the concentration, the higher the inhibition.

P. vulgaris was allowed to complete life cycle under 5% and 75% extracts. Effects affected germination, number of leaves, of nodes and distance between them. Length of pod, number, weight, individual weight per pod and number of seeds per pod were reduced when compared to control. Extract affected structure of plant, pods and seeds. Soil under plant showed it retains residues of inhibitory substances.

Washing of leaves by rain removes enough inhibitory substances to affect plant development in all seeds. Trichomes were removed and seeds exposed to them.

An attempt was made to determine if the plant contains volatile substances which inhibit germination of seeds. Covered seeds allowed to germinate in the presence of leaves of *L. camera* showed inhibition of germination probably due to presence of terpenes.

A study of *L. camera* in nature was carried out. Diamter of area under plant where no weeds were found growing was studied for 25 plants in all four stations. Results showed diameter is proportional to size and age of plant but no plant seems to be found growing in nature under *L. camara*.

THE USE OF MICROWAVE RADIATION TO CONTROL GROWTH AND REPRODUCTION IN FILTER CLOGGING ALGAE (CYANOPHYTA AND CHLOROPHYTA)

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A study of the effects of microwave radiation on representatives of the two major groups of filter clogging algae: Cyanophyta (blue green algae) and Chlorophyta (green algae) was made. Representatives selected for research were as follows: Cyanophyta-Anabaena, Oscillatoria, Chlorophyta-Spirogyra, Pediastrum, and Micrasterias. Algae researched in this study was subjected to microwave radiation utilized by the school. Times of exposure were from one minute to fifteen minutes. Five trials were performed on each set and average times were calculated. Controls were used as comparative taken at each level of experimentation. Parameters studied included color change, breakup of Chloroplast, fragmentation, and ultimate cell destruction of each representative algae species. Results of the research indicated that both groups were significantly effected as to growth and reproduction. The study showed that the Chlorophyta group began the breakdown cycle at three minutes, and the Cyanophyta group began to breakdown at five minutes. The structures of the two groups of algae differ. The cells walls of Cyanophyta, like those of bacteria, are composed not of cellulose but of the polymer murein. Outside the wall proper, there is a sheath of gelatinous material. In Chlorophyta, most of the cells are similar to one another and are not highly specialized; they form a single continuous tissue, which is the plant body. Futher investigations will be continued on additional representatives of filter clogging algae.

INHERITANCE OF RESISTANCE TO COLLETOTRICHUM IN STRAWBERRY

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Anthracnose-Crown rot, caused by Colletotrichum fragariae and possibly by C. acutatum, is a devastating disease of strawberries in the southeastern United States. We need to know the kind of gene action that produces resistance to different Colletotrichum spp. and the heritability of resistance to these species in strawberry in order to determine efficient breeding procedures to develop cultivars resistant to these fungi.

The progeny of nine crosses among strawberry clones were chosen for the genetic material. Up to 57 progeny from each cross were propagated by runners to produce four genetically identical plants. One plant of each progeny was prepared for inoculation with each isolate. Inoculum was prepared from three isolates of C. fragariae and one isolate of C. acutatum at a concentration of 1.5×10^6 spores/ml. The plants were inoculated and placed immediately into an unlighted dew chamber at 31°C to keep free water on them for a 48 hour incubation period. The reaction of each plant to each Colletotrichum isolate was recorded 12 days after inoculation.

Disease severity ratings varied among crosses and among isolates. Ratings for Goff were lower than those for other isolates, indicating that C. acutatum produces less severe disease reactions than C. fragariae. Additive genetic variance was present for each isolate but dominance variance was present only in La-1 and Fla-1. Heritability was relatively high for all isolates, indicating that sufficient progress could be made from selection for resistance to Colletotrichum spp. Simple mass selection would be the most efficient breeding procedure to transmit resistance into strawberry cultivars.

ALKALI ELECTROLYTES IN PLANT SOIL

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This experiment consists of one of nature's most valuable resources--soil. Within the soil, there are many salt particles with a wide range of varieties. The particular salts that I used in this experiment are alkali salts. They are unproductive, not because of a deficiency of plant food, but rather because of too many soluble salts. If a person has to work with alkali soils, the reduction of the soluble-salt content is very important, but it cannot be done by applying additional soluble material in the form of chemical fertilizers. This is where my experiment comes in. How can a person reduce these soluble salts? This experiment may have an answer to this question. I have chosen the simple and easy-to-grow spider plants for my project. Basic H, a Shaklee product, is the substance that I used to reduce the alkali salts in the soil of the plants. It is a biodegradable organic all-purpose household cleaner. The "soap" was mixed with water to create a solution, about 3 drops of Basic H to 50 ml. of water. The use of Basic H in this experiment takes the place of gypsum and calcium carbonate. Basic H organically provides a base to replace sodium. Electrolytes refer to salt and soil ions. In this experiment the electrolytes are broken down and leached out of the soil. Basic H causes these electrolytes to perform such an action. So far, farmers who have experimented with Basic H have come up with some interesting and promising results.

A TWO YEAR STUDY OF THE EFFECT OF A BIOELECTRIC FIELD ON GEOTROPISM IN ROOTS OF MAIZE

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There is a close association between indol-3-acetic acid and calcium in geotropism of roots. A previous year's experiment showed that primary roots of *Zea mays* suspended between a negative and positive electrode curved toward the positive electrode. This phenomenon was used to test the hypothesis that IAA causes root curvature and calcium helps transport IAA. Grains of *Zea mays* were sprouted and suspended vertically in a calcium chelating agent (EDTA). Roots were then suspended between copper electrodes in vials of water. 18 volts of DC electricity was applied to the wires in different trials. It was shown that roots with calcium removed still respond to the positive electrode. Subsequent trials with IAA applied to either side of the root indicated that IAA and not calcium is capable of working alone.

THE EFFECT OF PAIN RELIEVERS ON THE GROWTH OF THE BLACK-EYED PEA

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Black-eyed peas, when subjected to doses of pain relievers, do not respond positively. Selected plants of *Vigna sinensis*, from the Leguminosae family were given doses of a variety of over the counter pain relievers. Most of these contain aspirin, acetaminophen, caffeine & other medicinal compounds. Each black-eyed pea plant received daily doses of pain relievers dissolved in water, for a two week period. It became apparent that the drugs caused an adverse reaction to each plant. The plants either died or their growth was stunted. From my data, I concluded that pain relievers would not help plants that were subjected to extreme temperatures or were in shock.

#EFFECTS OF THIOETHERS AND SULFONES ON TRITICUM VULGARE AND PHASEOLUS VULGARUS

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Russian scientists have found that oxidation derivatives of thioethers (sulfones) increase spring wheat and rye yields by 15-20%. Utah has a natural supply of thioethers. My project entails the effects of these thioethers and oxidation derivatives of thioethers on the plants Triticum vulgare (wheat) and Phaseolus vulgarus(pinto beans) when applied before and after germination. I found that excessive amounts of thioethers or the oxidation derivatives of thioethers prevent germination and kill plants if they are well established. Small concentrations (from 1% - 10%) of the thioethers and its oxidation derivatives produce superior results when emulsified with water. The thioethers reduce the evaporation loss from both of these plants. It widens the leaves of the wheat plants and increases the wax content of the bean leaves. It delays the germination of both plants. The oxidation derivatives have most of the same effects as the thioethers. It also increases the speed of development in bean plants and it delays germination up to 4 times as long as does the same concentration of the thioethers.

#Fourth Award - General Motors ISEF

* RADIATION'S EFFECT ON THE PLANT TISSUE HORMONE, IAA

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INTRODUCTION: With the threat of an increasing amount of radiation in our enviroment from a decreasing ozone layer, the study of the impact of radiation on life forms has increased. This project illustrates the impact of radiation on one of the most important plant regulating hormones, indoleacetic acid (IAA).

PROBLEM: Does an increase in intensity of radiation cause an increase in the reduction of IAA's elongation properties in plant tissue?

PROCEDURE: Oat seeds were germinated. The coleoptiles were removed when the stems were at the proper length, and sections were taken. IAA was irradiated with 20 seconds of laser radiation. The stem sections were placed in control and experimental solutions. The control solution contained IAA in its normal condition, and the experimental solution contained the irradiated IAA. The solutions with the sections were placed in the dark for 24 hours at room temperature. Afterwords, both control and experimental sections were measured for elongation. The experiment was repeated testing the effect of irradiation of IAA at increasing amounts of intensity.

RESULTS: The control sections averaged elongations of 2.39 mm, with 98% of the sections showing elongation. The experimental sections showed an average elongation of 0.04 mm, with 3% of the sections showing elongation. Elongation of different exposure groups did not differ significantly from the experimental average of the groups.

CONCLUSION: A relationship of increased intensity/increased reduction of IAA's elongation properties does not exist.

*Third Award - General Motors ISEF

THE ISOLATION AND CULTURE OF PROTOPLASTS FROM *COSMARIUM BOTRYTIS* CELL SUSPENSION

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Protoplasts are spherical naked plant cells produced by the removal of the cell wall with digestive enzymes. They are usually derived from either leaf tissue or from cell suspension cultures and have been isolated from a wide variety of plant species. Plant protoplasts can be cultured in defined media and will form a cell wall, divide, and in many cases regenerate complete plants. The removal of the cell wall from plant cells, for example, has created new and exciting possibilities for exploring. In this project I have isolated protoplasts by subjecting an axenic cell production of the green alga *Cosmarium botrytis* to the enzyme cellulase while simultaneously stablizing osmotic pressure to prevent protoplast bursting. I have taken two ml of mannitol solution and placed it in a sterile tissue culture dish. One ml of cellulase solution which was sterile filtered was slowly discharged into the culture dish. One ml of algal culture was added by using a sterile pipette. The mixture was gently mixed again. The protoplasts were observed emerging for several days. Approximately 10-20% of these cells had released protoplasts after 24 hours. Some protoplasts broke up as they were emerging but others remained as dark green spheres. The protoplasts were transferred and grown as protoclones on culture media. The widespread interest in fusion of plant protoplasts lies largely in the hope of generating new plant species. Protoplasts are currently being used to study secondary product formation in plants. Results of this research will directly benefit biotechnology programs.

INDUCTION OF GERMINATION IN AVENA FATUA BY MECHANICAL INJURY AND SODIUM HYPOCHLORITE

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Hypothesis: Piercing and slashing seeds of wild oats (Avena fatua) can break dormancy and cause them to germinate. Treating seeds with sodium hypochlorite has the same effect.

Procedure: Dormant wild oat seeds were dehulled and pierced or slashed in various manners and sites. Others were left intact, injured and allowed to germinate. Dormant seeds were also dehulled or left intact and then immersed in a 5.25% sodium hypochlorite solution for various time intervals. Some were also slashed before treatment. The treatments with sodium hypochlorite were repeated with samples including some non-dormant seeds.

Conclusion: Mechanical injury was found to increase germination in dehulled seeds unless the embryo was damaged. This can be explained because the injury let in more water to the embryo. The effect of mechanical injury in intact seeds was very slight, probably because the hull restricts water intake. The germination of dormant wild oat seeds was increased by sodium hypochlorite treatments. This can be explained because sodium hypochlorite can increase the permeability of the seeds to gases and water. The dehulled and slashed seeds had a lower germination than those without the sodium hypochlorite treatments. This shows that a great intake of sodium hypochlorite can damage the embryo. Those seeds that were left intact had no germination, which again shows how the hull restricts germination. The seeds that were treated dry supported these conclusions.

OGO--AN ANSWER TO WORLD HUNGER

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Gracilaria coronorapafolia, commonly known as Ogo, grows in tropical climates where the physical parameters of the water temperature ranges from 26° to 32°C and the photoperiod is at its maximum throughout the year when compared with the rest of the world. The purpose of my project was to be able to overwinter the alga with artificial light so it could survive until the physical parameters returned to longer days. I placed five pounds of Ogo into a circular fiberglass tank three feet in depth and having a diameter of eight feet. I placed one ounce of Ogo in a fifty-five gallon glass aquarium, which became my control tank. This tank was exposed to sunlight. In the large tank I placed oyster shell to control the pH, a submerged water pump for filtration, a paddlewheel to stir the water, an air pump, and I had chemical kits to monitor fertilizer, carbon dioxide, and dissolved oxygen. The results of my project were that, after five months, six pounds of Ogo grew in the large tank and eleven ounces grew in the control tank. More data will be collected during the summer months to watch the growth of the alga under varied light intensity. The data proved that one can overwinter the alga with artificial light. What will it do now? I have moved the alga outside to see if the stunted alga from the large tank will begin to grow as the alga from the control tank or if it will continue to be stunted.

# VARIATIONS OF COMPONENTS AFFECTING FROST HARDINESS IN WASATCH CONIFERS

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The Wasatch mountains of Utah are dominated by conifer trees which survive cold winter months without freezing. My experiments sought to isolate the component of conifer needles responsible for this phenomena. I also sought to determine if that resistance were a genetic adaption to geographic elevation or a survival mechanism common to all of the conifers regardless of elevation.

Cross elevational samples were taken as well as a sample from an elevational transplant. These samples were tested for water content, glucose levels and solute concentrations. Factors such as sunlight, watershed, soil type, and age were carefully controlled. The effects of the variables temperature and elevation on concetrations of solutes was studied. All experiments were repeated several times throughout the winter of 1986 and results recorded.

Experimental data shows that as the temperature the tree is exposed to decreases, glucose levels within the needles increase, while other solute concentrations remain constant. The water levels within the needle also remained constant. Glucose and solute levels decrease in concentrations as temperatures warmed with time. The transplanted conifer more closely resembled trees from the area it was transplanted from, than the trees in the area it now grew.

In conclusion : The genetic code within conifer trees maintains high concentrations of glucose within the needles. This highly saturated sap is then capable of withstanding extremely cold temperatures. Local environment has only minor effects on glucose concentrations.

#Fourth Award - General Motors ISEF

ARE SOME LEAVES A BETTER SOURCE OF MULCH THAN OTHERS?

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PURPOSE: The main goal of this project is to find out if different types of mulch extracts can provide a good growth environment for different types of vegetable seedlings.

PROCEDURES: (1st) Gather different types of leaves and let dry for about 10 days. (2nd) After they have dried, soak them in water. Use a ratio of 500 ml of water at 65°C for every 30 grams of leaves. (3rd) Add a drop of liquid soap to each of the leaves to cleanse the compost. Then blend the leaves, the drop of soap and the water together for about three minutes. Finally, refrigerate the mixture for about 48 hours. (4th) Wash about 50 lbs. of sand in soap and water, rinse it well, then dry it by baking it at 500°F for about 15 minutes. (5th) Add the sand to 9 oz. cups using 216 grams of sand for each cup used in the experiment. (6th) Plant the seeds in the cups after the sand has cooled and water with the solutions once every other week. (7th) Finally, place a flourescent light fixture above the seedlings to provide sufficient light for growth. Keep the light on at all times until the experiment is complete.

RESULTS: The results showed that some leaves are a better source of mulch than others.

CONCLUSIONS: The best leaf mulch was the Ground Ivy leaf. The worst was the Oak leaf. The seedling that adapted best to the growth environment was the corn seed. The seedling with the worst germination percentage was the bean seedling.

#BIOLOGICAL CONTROL OF FUSARIUM WILT IN CUCUMBERS

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This experiment was performed to discover if a synergistic effect in controlling fusarium wilt in cucumbers occurred when both soil mixing and seed coating were used as application methods for *Pseudomonas putida*. Soil from the Gnotobiotics Lab at Colorado State University was combined with a mixture containing *Fusarium oxysporum*, a plant pathogen that causes the plant disease fusarium wilt. Then an equal amount of soil was put into each of the 80 pots used in the experiment. The bacterium *Pseudomonas putida* was used as a biological control agent. It was added to the soil and also to the seed as a coat, both in varying amounts. Cucumber seeds were then planted in the pots, which were placed in a greenhouse. The plants were watered twice daily with a standard nutrient solution, and after the plants had germinated they were thinned so that there were five cucumber plants in each pot. After two weeks, the percentage of diseased plants in each pot was recorded. Experimental results were recorded on alternating days for an additional three weeks, and the data was analyzed for statistical significance. It was found that a synergistic effect in controlling the disease did not occur. It was also observed that once a certain number of bacteria were present either in the soil, on the seed, or both, additional *Pseudomonas putida* added did not further suppress fusarium wilt in cucumbers.

#Third Award - General Motors ISEF

EFFECTS OF A VACUUM ON A CUCUMBER

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The purpose of this project was to determine the effects of a vacuum on the bacterial counts and the physiological composition of cucumbers. The following hypotheses were formulated: (1) A vacuum reduces the aerobic bacterial growth in cucumbers. (2) The vacuum alters the physiological composition of cucumbers in color and odor. (3) Mass loss is minimized in an enclosed environment. (4) A vacuum reduces visible bacterial growth.

Three groups of cucumbers - control open containers, closed containers and vacuum containers - consisting of four containers labeled by duration of experiment (5, 10, 15 and 20 days) were placed in a refrigerator (4°C). When the time of experimentation had elapsed, the specimens were measured for mass changes. Visual observations were also made. Then, the specimens were plated for bacterial counts.

After twenty days: (1) The control cucumbers average $2.5 x 10^8$ colonies per gram; closed container specimens average $5.3 x 10^7$; and the vacuum specimens average $7.5 x 10^5$ colonies. (2) Control cucumbers have lost firmness, darkened in color, developed a rancid odor and dehydrated. The vacuum specimens turned a waxy yellow-green and developed a potent vinegar-like odor. (3) Control cucumbers average a 72% loss of mass; closed specimens average a 19% loss; and vacuum specimens, a 10% loss. (4) Of the three groups, the control was the only one with qualitative growth. These specimens develop patches of white, cottony growth.

*MORPHOLOGICAL, TAXONOMICAL, ECOLOGICAL, BIOCHEMICAL AND STATISTICAL STUDY OF TWENTY-TWO FERN SPECIES WITH SPECIAL ATTENTION IN THE PHARMACOLOGICAL PROPERTIES OF Polypodium polypodiodes - RESURRECTION FERN

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The purpose of this investigation is to study morphologically, taxonomically, ecologically and chemically twenty-two ferns species and to separate and identify the active compounds responsible for the pharmacolgical properties of Polypodium polypodiodes - Resurrection Fern. A variety of twenty-two ferns species were located, identified and classified emphasizing its external and internal structures, development of life cycle, distribution of habitats using morphological and taxonomical keys personally design, preparation and staining of fern tissues. Pteridium aquilinum, Gleichenia bifida and Polypodium polypodiodes were the species used to study the development of life cycle. Using the quadrant techniques species were found growing in small groups and different habitats on the area following a definite pattern of growth and distribution being affected by climatic and edaphic factors that were studied by using climatolgical instruments and data, analisis of the soil. Separation and identification of biochemical characteristics of fern pigments were obtained through Paper, TLC, U.V. and Spectrophotometry revealing that ferns have chlorophylls a, b, carotene in smaller quantities and a great amount flourescence, that chlorophyll a absorbs lights more rapidly. Chemical analysis of P. polypodiodes involved methods like P.C., TLC, Wall method, to obtain an active spots of cardiotonic glycosides at 30 and 40 microliters. Identification of specific cardiotonic glycoside is in process through CC. GC. and H P L C methods. For the pharmacological test, the water flea crustacean Daphnia pulex was used. Daphnia was exposed to diferent concentrations of the fern plant infusion to control the rate of heartbeat with a possitive result. Results of all phases were analized statistically.

*Second Award - General Motors ISEF

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*The Microgravitational Effects on the Physiology and Growth of Anaerobically Germinated Raphanus sativus: A Pre-launch Study

Jay Scott Andrews Fayetteville-Manlius High School
7041 Cavalry Circle, Manlius, New York 13104

The purpose of this study is to determine the effects of microgravity on the physiology and growth of the radish, Raphanus sativus, under anaerobic atmospheric conditions. Preliminary tests are being conducted to establish standards for comparison with results obtained during the space shuttle Columbia's scheduled July 15, 1987 flight.

Preliminary results demonstrate Methylene Blue supports germination in the absence of molecular oxygen, however growth of seeds that germinated was slow. Anaerobic germination is theoretically impossible. These experiments are designed to determine methylene blue's role in anaerobic germination. It is hypothesized that Methylene Blue is allowing some ATP synthesis by functioning as an electron acceptor in the respiration chain. Since Methylene Blue is not as strong an oxidizer as molecular oxygen, less ATP is synthesized than in aerobic conditions. This may account for the observed decreased rate of growth.

Under aerobic conditions methylene blue increases the percent of seeds germinating followed by a decreased rate of growth. Root hairs and secondary root structure deterioration is observed and likely accounts for the decreased rate of growth. A possible explanation to explain the increased percentage of germination is that methylene blue alters membranes structurally, thereby changing vital hormonal equilibria during germination allowing greater viability of seeds.

*Fourth Award - General Motors ISEF

MEASURING THE AMOUNT OF HEAT GIVEN OFF BY RADISH AND GRASS PLANTS

Thaeler, Andrew S., St. Joseph High School, Ogden, Utah 84401
1540 East Gentile, Layton, Utah 84041

My project involves measuring the heat given off by *Raphanus Sativus* (Cherry Red Radish Plants) and *Poa Pratensis*. (Long Stem Kentucky Grass) I started my project by writing a research paper on respiration, transpiration and photosynthesis. These three chemical processes are the sources of heat in plants. In writing this paper, I learned that open enviroment testing was not accurate enough for my experiment. Instead, I chose the closed enviroment of a thermos bottle. I began by growing several test plants. From those test plants I removed several ounces of stems. I filled three thermos bottles with equal amounts of water. For use as an experimental variable, I filled a fourth bottle with soil. In the first bottle I placed the radish stems. In the second bottle I placed the grass stems. For use as a control, I left the water in the third bottle alone. I sealed the bottles with corks. I placed the thermos bottle in an incubator to the the temperature stabilize. Several hours later I drilled through the corks and inserted calibrated thermometers. I measured the temperature of the water and the soil in the bottles. Under the correct conditions, grass and radish plants do give off a considerable amount of heat.

ANALYSIS OF HYDROPONICALLY GROWN SUNFLOWERS (*Helianthus annuus* L.) WITH DEUTEROMYCETES

Geck, Mary K., Mandan H.S., Mandan, ND 58554;
409 12th Street, NW, Mandan, ND 58554.

No exhibit.

#AN ANALYSIS OF MIMOSINE CONCENTRATION IN LEUCAENA LEUCOCEPHALA AND ITS EFFECT ON FLORIDA RUMINANTS

LaMothe, Eugene R., Crestview H.S., Crestview, FL 32536;
Rt. 4 Box 320 A, Crestview, FL 32536.

The tropical legume *Leucaena leucocephala*, has gained increased popularity as an animal feed in recent years. Its ability to grow in harsh climates and its beneficial attributes for poor soil have widened its uses as an all-purpose crop. Recently, however, the plant has been found to contain the chemical Mimosine. This chemical has been linked to hair loss, low weight gains, and even death to the cattle that graze on it, thereby restricting the commercial value of the forage.

A study was made to determine the percentage of Mimosine in Florida cultivars of *Leucaena leucocephala* using various methods of storage. Optimum conditions were obtained with the storage process of freezing and freeze drying which yielded lower percentages as opposed to oven drying the plant which yielded higher percentages. The results of this study have implications for reducing the toxicity of *Leucaena leucocephala* used for stock feed.

#Fourth Award - General Motors ISEF

# A COMPARATIVE ANALYSIS OF EFFECTS OF SOIL BACTERIA IN PLANTS

Longshore, John W., Gadsden High School, Gadsden, AL 35901;
607 South 12th Street, Gadsden, AL 35901

The purpose of this project was to determine at which stage or stages in plant life the absence of helpful soil bacteria is most devastating. Experimentation was designed for the germination, growth, and productive stages.

Phase I: In phase I identical seeds were planted and grown in the same environment. Soil for the experimental and control groups was the same except the soil for the experimental group was heated one hour at 500° to kill bacteria. The conclusion was based on length of germination, number of seeds germinating, and vigor of plants.

Phase II: Phase II experimentation tested the effect of soil bacteria on plants during their growing stage. Plants were pair matched for size and vigor. Transplants were used to eliminate the detrimental effects caused by the absence of bacteria during the germination period. The analysis was made from the amount of growth and plant vigor through maturity.

Phase III: Phase III was a study of long-range effects on phase II plants with emphasis on productivity. The conclusion was based on the plant's age at the time of productivity, amount of productivity and length of productivity.

Conclusion: Three years of researching and experimenting led to the following conclusion: Plants germinate in a shorter time period, grow faster, larger, and produce more when soil contains helpful bacteria. The absence of bacteria is more detrimental to germination than growth.

#Third Award - General Motors ISEF

DEVELOPMENT OF A NATURAL VIRUS TO CONTROL A NOXIOUS PLANT

Keith, Brenda Young, Hartville High School, Hartville, MO 65667
Hartville, MO 65667

The multiflora rose, that was once introduced by the conservation department for wild life refuges, has become a common nuisance. Once thought to not be able to reproduce in large numbers or be transported to new areas by birds has been proven wrong by problems that the multiflora roses have now caused. In many areas, where the multiflora roses were introduced during the 1950's, the pest has completely taken over the undeveloped land and moved to pasture lands, which have robbed the farmer of many acres of valuable grazing land. The problem has been recognized by the government, local officials and farmers. The major control of this plant is by the use of chemical herbicide, which is sometimes toxic and costly as well as controlled. Considering these facts, the project's intent is to isolate the multiflora rose's natural enemy--a known domestic rose virus--, test to find adverse effects on the multiflora rose and experimentally determine if the virus can be transplanted artificially from one plant to another on a mass scale with satisfactory results in the control of the over abundant multiflora rose population. The laboratory production of the virus, the ecological effects on other plants and soil are also experimentally tested. The experimentation in each area was exceptionally high in successfulness with the project's intent and show good prospects in some type of commercial or mass type use on the control of unwanted multiflora rose populations.

CRYOPRESERVATION OF SEEDS

Sydow, Jason P., Western Albemarle H.S., Crozet, VA 22932
2315 Gersandy Pl., Charlottesville, VA 22901

In my research and experimentation I attempted to prove that large seed types need different freezing specifications than smaller types. The basic concern in the cryopreservation of living material is to prevent the nucleation of ice crystals during freezing. When ice crystals form they rupture organelle and cell membranes. When a large seed type, corn, is soaked in a cryopreservative solution it retains more water than a small seed type, tomato. For this reason I felt that corn would have different freezing specifications than tomatoes. I tested this by freezing tomato seeds using specifications my research showed were most productive and then freezing corn seeds at varying specifications. I then compared the percent germination of the different groups.

The freezing specifications that I tested were the percentage and soak time with DMSO and glycerol, cryopreservatives that prevent or lessen the nucleation of ice crystals.

I also tested the effect of prefreezing seeds in a dry ice acetone both before freezing in liquid nitrogen. Through my results I proved that a large seed type had different freezing specifications than a small seed type. I also determined what the optimum freezing specifications were for corn seeds.

#DEVELOPMENT OF WOODWARDIA VIRGINICA PROTHALLIA AS A FUNCTION OF X-RAYS

Mitchell, Gerald A., Alcorn Central High School, Glen, MS 38846;
Route 6 Box 53, Corinth, MS 38834.

The experimentation was designed and performed over a two-year period to determine the effects of increasing low levels of X-radiation on the development of *Woodwardia virginica* prothallia. Ultimately, a curve was constructed to represent this development mathematically.

It was believed that X-rays would cause reductions in the number of chloroplasts, irregularities in cell shapes and sizes, suppressed cell divisions, and non-germination in a number of spores, according to the size of the dose of X-radiation delivered by the 65kVp machine used.

It was found that 3mA produces several harmful effects - swollen and elongated cells of prothallia and swollen rhizoids. The prothallia in the 6mA group also had swollen rhizoids. In the 9mA group, elongated cells were produced. The prothallia in the moderate dose levels (6mA and 9mA) underwent something phenomenal - stimulation of cell divisions, while suffering relatively few destructive side effects. The highest dose levels produced the most harmful effects on the development of the prothallia. The 12mA group suffered a reduction in the number of viable prothallia and a significant change in pigmentation due to an acute lack of chloroplasts. The 15mA group had the highest number of ungerminated spores, a reduction in the number of viable prothallia, a change in pigmentation due to agglutinated chloroplasts, a reduction in the number of chloroplasts, and elongated cells of prothallia.

The hypothesis was proven correct; however, the beneficial effect of stimulated cell divisions in the 6mA and 9mA groups was not expected at the outset.

#Second Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

THE HYBRIDIZATION OF L. ESCULENTUM WITH L.PENELLII FOR COMMERCIAL HALOPHYTISM

Cheng, Tai W., Manatee High School, Bradenton, FL 33505
6844 14th Street West, Bradenton, FL 33507

In this second year research, two generations (F_1 and F_2) of Lycopersicon esculentum cv. Hayslip X L. penellii cv. LA716 were developed. During the first year F_1 was made, and both parent strains were tested for the degree of salt tolerance. LA716 was shown to be more tolerant to NaCl treatments than Hayslip under greenhouse conditions. On the second year two sets of experiments were made. The first experiment tested F_1 for range of salt tolerance by analyzing the internal and the physiological responses. From the internal responses it was shown there was a high correlation between %Na+ and %Cl- in relation to the toxicity of the plant. A significant increase of %total N in the plant tissue with respect to the increased concentration of NaCl treatment show that the high NaCl environment triggered an increase in production of nitrogen related materials such as amino acids. From the physiological responses (wilting, chlorosis, and nerosis), F_1 was concluded as being salt sensitive, therefore, showing halophytism as a recessive trait. The fruits produced by F_1 were the size of cherry tomatoes, and the color ranged from red to orange-yellow.

The second experiment is being conducted. This project was designed to demonstrate as an inexpensive alternate in reutilizing salt-strickened farmlands, and the success may open vast, new resources such as sea water and coastal deserts for increasing the production of useful biomass.

A Comparative Study of Poisonous and Non-Poisonous Plants to Produce an Antibacterial Agent

House, Victoria Lynn, Laurel County High School, London,KY 40741, Rt.6 Box 551, London,KY 40741

The purpose of this project is to acquire an antibacterial agent originating from microbes produced by poisonous and non-poisonous plants. Only a small quantity of the microbes studied are expected to produce antibiotics.

The researcher begins her experimentation by first obtaining samples of various poisonous and non-poisonous plants. The methodology used to extract the chemicals from the plants is a simple steeping procedure. After these steeped solutions are procured, they are placed in storage containers at room temperature until a culture of microbes is established in each solution. The solutions are then pressured for twenty minutes at 240 degrees Fahrenheit. Blank sterile disks are submerged in each solution and placed on a culture of Staph. Epidermis. After twenty-four hours of incubation, the cultures are examined and the results are recorded. The solutions are then tested on E. Coli and on a yeast infection called Candidia Albicans.

The researcher found that Sumac leaves, Comfrey, and Lavender are effective in the inhibition of Staph. Epidermis, but none of the plants are effective against the E. Coli or the yeast infection.

Further experimentation is being performed in a more sterile environment to verify the origin of the agent. These results will be announced at a later date.

APICAL DOMINANCE AND GRAVITROPISM IN SUGARCANE

Tai, Thomas H., Pahokee Jr. Sr. High School, Pahokee, FL 33476
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Sugarcane (*Saccharum* sp.) is a member of the grass family, *Gramineae*, and one of the primary sources of the world's sugar. Apical dominance, the repression of the growth of lateral buds by the growing point, is a plant development phenomenon which has not been researched to a great extent in monocotolydenous plants, such as sugarcane, due to its complexity. Gravitropism (geotropism) is the reaction of plants to the force of gravity. The objective of this study was to examine the characteristics of apical dominance and gravitropism in sugarcane.

Nine genotypes of sugarcane were used for this study. Tests on apical dominance included the measurement of the activity of the lateral buds following the decapitation of the cane stem and the measurement of the inhibition of the lateral bud growth by placing agar blocks with extractants from the cane shoot growing points on the decapitated stems and by placing bud chips on agar blocks. The reaction of sugarcane stem to gravitropism was measured by the change of angle of the shoot apex from the horizon. The results indicated that the domination of apex over lateral bud activity (growth or inhibition) was dependent upon the genotype and the position of the lateral buds on the stem. The agar blocks with the cane shoot extractants did not produce as an effective inhibition on the lateral bud growth as did the non-decapitated stems. Young sugarcane bud chips showed greater activity in three culture media (plain agar, agar + indoleacetic acid, and water) than in the agar + shoot extractant media. Gravitropism was also dependent upon the genotype and the vigor of the cane growth.

ATMOSPHERIC ACIDITY AND ITS INITIAL EFFECTS ON WHEAT

Thomson, Eric M., Weber High School, Pleasant View, UT 84404;
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Recognizing that "acid rain" is a world wide concern, and that the effects of atmospheric acidity (acid rain) may significantly affect food crops, this project was designed to study the effects of increasing levels of acidity on one of our nations most important cereal grains.

Over a period of three months, six different groups of wheat plants were germinated in sterile soil, subjected to light conditions comperable to normal growing conditions, and watered (sprayed) with a water solution ranging from pure distilled, pH 6.0, pH 5.5, pH 5.0, pH 4.5, to pH 4.0. The visible effects on the growing plants of the one variable were noted and documented.

The findings of my study were that after only three weeks of growth, burn spots began to appear on plants subjected to a water/acid solution of pH 4.0. The effects appeared first on the lateral leaves that apparently hold moisture longer than the vertical primary growth of the plant. After four weeks of growth, even plants watered with an acidity level of pH 5.5 showed detrimental effects.

The three month study has lead me to conclude that normal rainfall of pH level 5.4 - 5.8 is generally tolerated by normal wheat crops. Acidity levels in excess of 5.4 is detrimental to overall plant growth, however; the lack of normal nutrients available to plant growth is lacking in sterile soils. Without introducing another variable, of increased fertilization, I found continuing this experiment to conclusion of fruiting plants and harvest of mature grains to be inappropriate and not feasible.

# NODULAR INDUCEMENT BY *RHIZOBIUM MELILOTI* CONTAINING TWO NODULATION REGIONS

Battinelli, Elisabeth M., Somerville High School, Somerville, MA 02143
22 Hudson Street, Somerville, MA 02143

The initial phase of my study was to demonstrate that the nodulation region of *Rhizobium meliloti* could be tri-parentally mated into *Rhizobium trifolii*. Both of these bacteria are known for their ability to form nodules that carry out effective nitrogen fixation. The *Rhizobium meliloti* has the ability to nodulate alfalfa plants, while *Rhizobium trifolii* can nodulate clover plants. The resulting strain of bacteria would have the ability to nodulate alfalfa plants, but not clover plants, since the *Rhizobium trifolii* has been cured and the *Rhizobium meliloti* plasmid has been mated. After carrying out the experimentation, however, I discovered that this bacteria was rather weak and was not able to propagate well. This I determined was due to the size of the plasmid that had been mated (8.7kb).

The second phase of my experimentation involved the mating of two nodulation regions into two different strains of *Rhizobium meliloti*. One strain contained a megaplasmid, while the other held only one small plasmid segment for nodulation. The strain that contained the megaplasmid is capable of carrying out nitrogen fixation, while the strain holding the small plasmid segment does not. Both of these strains would then have the ability to carry out effective nodulation and nitrogen fixation. I also wanted to demonstrate that when the bacteria were recovered from these nodules, they could be characterized as being Tetracycline resistant when grown on a medium containing the antibiotic. This phase of my study is still in process (April 22, 1986). Throughout the experiment, nodulation was studied microscopically and Eckhardt gels were carried out to prove the presence and absence of plasmid regions.

#Scholarship - United States Navy/Office of Naval Research
Second Award - General Motors ISEF

# SEASONAL VARIATIONS IN THE LICHEN *XANTHOPARMELIA CUMBERLANDIA*

Lindauer, Kevin L., John F. Kennedy H. S., Denver, CO 80227
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Thalli from a lichen, *Xanthoparmelia cumberlandia*, were collected from four sites in New Mexico, Colorado, and Wyoming during 1983 to 1986. The primary purpose was to determine the morphological and physiological responses, and population sizes or quantities in different habitats. Significant changes occurred in the thicknesses of the upper and lower cortex, algal layer, and medulla in the thalli from warm and dry seasons to cool and wet seasons. Thicker medullary and algal layers tend to form under optimum environmental conditions, late fall to early spring, and thicker, tougher cortical layers under harsher environmental conditions in late spring to early fall. Significant changes in the ratio of phycobionts to mycobionts were also observed from season to season. These changes can be beneficial to the lichen if sufficient time is allowed for production of biomass and less beneficial if the lichen can only persist during environmental stress. If there are chances for survival, a lichen can respond to adverse conditions by undergoing morphological adjustments (thicker cortical layers) and by changes in the phycobiont/mycobiont ratio. The plasticity of lichens is a result of the actions of a complex of environmental factors. They can respond by making ecological adaptations which lead to reproduction and growth. Therefore, the ultimate survival of this species seems to be primarily a function of its plasticity.

#First Award - General Motors ISEF

THE EFFECTS OF MICROWAVES ON BEAN SEEDS

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In doing this project, my goal was to observe the effects microwaving would have on bean seeds when planted and allowed to grow into mature plants. These changes would be caused by mutations-slight changes in the DNA.

In this experiment, I used two types of bean seeds: Burpee Stringless and Blue Lake 141. The characteristics I looked at were: height achieved by the plants, leaf shape, and the "fruit" produced.

In my microwave at home, I microwaved ten seeds at a time on high power at intervals of five seconds. (Thirty seconds was found to be the lethal dose.) The seeds were planted in the school greenhouse.

As they grew, I photographed the plants and recorded their unusual characteristics.

I microwaved seeds at two different times. The first is Group A, the second, Group B. The seeds produced by these two groups were planted in an effort to determine which characteristics were passed on to the next generation.

The types of mutations observed were: delayed production of leaves, odd leaf shape, stunted or increased growth, production of many flowers, and production of very large or small seeds. Most of these characteristics were inherited by the second generation.

Microwaving seeds could be used as a way of getting faster growing or disease resistant strains. Plants with favorable characteristics could be cross-pollinated to produce plants with those characteristics.

A COMPARATIVE STUDY OF INORGANIC AND ORGANIC FERTILIZERS

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The research of this study of inorganic and organic fertilizers was chosen because of my interest in agricultural. The plant chosen to experiment with was the Phaseolus Lunatus, commonly known as the bush butterbean. The project began in June of '85 and lasted until the summer season ended and a frost came.

The rows were 60 ft. long and the beans were dropped 18 to 22 inches apart. Fertilizers of each kind were distributed as evenly as possible. Inorganic Fertilizers used were: 6-24-24; 12-12-12; 8-8-8; and Super Phosphate. The Organic Fertilizers were: Cow Manure; Rabbit Manure; Sheep Manure; Chicken Manure and Potting Soil. One row was planted without any fertilizers to serve as the control. Plant height, leaf width, leaf length, plant color, production of beans, and bean flavoring were recorded every three days.

In conclusion to the research that has been compiled for this study, the best inorganic fertilizer to use is 6-24-24. The best organic fertilizer was Rabbit Manure. The best over all was the inorganic fertilizer, 6-24-24. It is easier to obtain, easier to distribute, the plants produced more beans, and the taste of the beans were more desirable. When calculating the cost, the inorganic forms are more economical as well.

INHIBITION OF MOSS GERMINATION BY THE CHEMICALS RELEASED FROM LICHENS

Larson, Mora A., Loudoun Valley High School, Purcellville
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Allelopathy is the release of growth inhibiting chemicals by plants, which can reduce competition for growing space and nutrients. Spores of *Polythricum commune* moss were sown in 20% Hoagland's nutrient solution, containg three types of lichens; *Parmelia perlata*, *Parmelia caperata*, and an unidentifiable *Cladonia* species. Percent spore germination was determined for each of the three dishes containing lichen and compared to spore germination for the control, which did not contain any lichen. The experiment's intent was to see if the lichens used allelopathy to inhibit moss spore germination.

Allelopathy, an uncharted concept in botany, may be considered in lichen evolution as a basic means of competing with faster growing species. It may also clarify the reasons plants have their own space on earth. Without allelopathy, plants would be growing all over each other, competing by strangulation or light-hogging, rather than warding each other away with chemicals. It is survival of the fittest, chemically.

This experiment could have agriculturally important results if an organic herbicide could be economically produced from lichen. This would take much further study. More importantly is the need for further lichen studies. Their contribution to soil formation, antibiotics, perfumes, etc. is something that should be understood and appreciated.

THE EFFECT OF GIBBERELLIC ACID ON BEAN AND CORN PLANTS

Blanchard, Simone M., Leesville H.S., Leesville, LA
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This research was done in two parts. Part I was to determine the effect on plant growth of gibberellic acid (GA_3) application to the roots of plants, while Part II was to determine the effect on plant growth of soaking the seeds then applying GA_3 to the roots.

It has been documented that GA_3, applied to the foliage of plants, will significantly increase the growth rate.

In Part I, bean and corn seeds were grown using GA_3 solution applied to the roots. The results showed no significant difference between those supplied with only water under the same conditions.

In Part II, bean and corn seeds were soaked in GA_3 solution prior to germination. These were then grown for fifteen days using the same technique as in Part I. These results also showed no significant difference in the growth rate of the bean plants; however, a noticeable significant difference was shown in the corn plants.*

It must therefore be concluded that in order for GA_3 to effect the growth rate of bean and corn plants it must be applied to the foliage not to the roots.

*Although not proven, the experimentor believes that this could be due to the position of the embryo in the corn seed.

HOW DOES THE DISEASE CRONARTIUM QUERCUUM FUSIFORME (FUSIFORM RUST) AFFECT AND DAMAGE LOBLOLLY AND SLASH PINE TREES?

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1008 Southeast Circle, Hattiesburg, MS 39402.

The objectives of this study were to determine how and in what ways Fusiform rust affects loblolly and slash pine trees; to compare the internal effects of the disease on representative samples of tree stems; to get representative samples for reasonable statistics; to find the number of trees infected in a given area; and to determine if there is a variation in gall types, and how this variation affects the life and value of the trees studied.

Since there were numerous gall types possible, it was believed that infection would be greater in some areas and lesser in others producing a devastating effect on the life or death of the trees studied.

It was found that:

1. Fusiform rust causes swelling on the branches and stems of loblolly and slash pines while ruining the value of marketable trees by reducing growth and deforming them.
2. A healthy tree stem compared with a diseased stem of approximately the same age is very different in diameter. The healthy stem appeared normal in every aspect while the diseased limb was greatly enlarged and distorted.
3. Fusiform rust was found to be evenly spread throughout pine plantations.
4. Various types of galls are a determining factor in the life or death of diseased trees.
5. Removing oak trees and pruning branches are the only practical methods for reducing rust infection.

# THE EFFECTS OF VARIOUS ADDITIVES ON THE SALT TOLERANCE OF MILLET CELLS

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Salt tolerance in food crops is becoming increasingly important in the effort to end starvation. This experiment attempted to determine whether the addition of various sugars, mannitol or 3-0-methylglucose, or an amino acid, proline, to their growth medium could increase the salt tolerance of Proso Millet (Panicum Miliaceum) cells.

This was accomplished by growing cultures of millet cells, derived from callus, in media containing 4% sucrose, 2% sucrose, and 2% sucrose plus either mannitol, 3-0-methylglucose, or proline. Each of these media was made either saltfree or with 130 mM NaCl, resulting in ten defferent media. Three flasks of cultures were made with each medium, thirty in all, and these were kept in a shaker at 25°C. The cultures were scaled each week and the scale numbers converted to dry cell weight with computer software. Cultures that had reached maximum size were recultured and maintained. Sterile tissue culture techniques were used throughout the study.

The 4% sucrose culture grew well even with salt, due to the extra energy provided by the sugar. The 2% sucrose culture was killed by the salt. The mannitol and 3-0-methylglucose did not appear to affect the salt tolerance of the cells. The proline appeared to increase their salt tolerance very slightly.

These results are rather inconclusive, and more research is needed in the area of salt tolerance in food crops.

#Third Award - General Motors ISEF

REGENERATION OF SHOOTS FROM HYPOCOTYL DERIVED CALLUS OF BLACK LOCUST, *ROBINIA PSEUDOACACIA L.*

Chao, Jerome D., Sleepy Hollow High School, N. Tarrytown, New York 10591
Country Club Lane, Scarborough, New York 10510

Using tissue culture techniques, shoot regeneration in deciduous black locust plants was examined. An attempt was made to increase the efficiency of *in vitro* shoot regeneration from callus derived from hypocotyl segments of black locust, *Robinia pseudoacacia L.* The specific tissue samples taken from black locust seedlings were grown under controlled conditions in sterile media differing in salts and hormone concentrations. The samples were later transferred to a second set of media containing no auxins, and shoot regeneration was observed. The highest shoot production rate, 10.5 percent, was obtained using MS agar solidified medium containing 10 uM BA and 1 uM 2,4-D as the callus culture nutrient medium and MS agar solidified medium containing .1 uM BA for shoot regeneration.

EFFECTS OF VITAMINS ON BROCCOLI AND TOMATO PLANTS PHASE II

Brad Dishman, Vinita High School, Vinita, OK 74301
925 West Clyde
Vinita, OK 74301

In my science fair project I grew tomato and broccoli plants the usual way. I added additional vitamins to the plants leaving two of each type of plant getting only water. The vitamins I used were A, B, C, D, E, Centrum Junior, and Centree (multivitamins). The control plants received water only. The purpose of this experiment was to see what effects the vitamins would have on the growth of the broccoli and tomato plants. Each week I took measurements of the height and stem growth of the plants and found that the vitamin B plants were growing faster than the rest of the plants. The vitamin C stunted the growth in the plants.

OLDIES BUT GOODIES? CAN VIABILITY BE INCREASED BY ALLOWING LEAVES TO AGE BEFORE CLONING?

Bigbv, Lori Anne, Dixie H.S., Due West, SC 29639
Route 1, Honea Path, SC 29654

In preliminary studies using *Saintpaulia sp.*, it was found that older detached leaves clone better than newly detached ones. Research was done to test the accuracy of these results using African Violets and Gloxinia. Variables introduced were different media and time elapsed before cloning. These were done to see if results occurred due to the composition of the medium, the variable of waiting before cloning, or a combination of the two. To insure that all explants were the same size a hole puncher was used. All explants were placed under a fluorescent light having a fourteen hour day and a ten hour night, activated by a timer. Each explant received an equal amount of light because the vials were rotated. All work was done under aseptic conditions. The rate of shoot production and the viability of the explants has been observed.

*HEALING HERBS, FACT OR FOLKLORE

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Three experiments were conducted. Different subjects were utilized for each individual experiment. The first experiment was conducted to determine the probability of the salve acting as an illness-inducing substance. A conditioned taste aversion was performed. Due to the fact that no aversions were found,it was concluded that the salve is not an illness inducing substance. The second experiment was conducted to determine an increase or decrease in the healing rate with the use of the salve on premade punctures,performed by a lab tech.,with the use of blood lancets,as compared to other con trol groups. Group A-salve, Group B-petroleum jelly, Group C no dose. All subjects in Group A healed by or before Day 15, all subjects in Group B healed by or before Day 18, and all subjects (excluding one) in Group C healed by or before Day 18. It is therefore concluded that Group A had a faster healing rate than Groups B and C. The third experiment was conducted to determine the probability of the salve affecting the subjects' rate of activity. Five days of baseline running in Activity Chambers preceded exposing the subjects to the salve. Subjects were again placed into the chambers and tested for an increase or decrease in activity (Days 6 to 10). Five more days of baseline running followed salve exposure days. All subjects showed an increase in their activity rate between Days 6 and 10. It is therefore concluded that the salve possesses stimulant qualities and does affect the subjects rate of activity.

*Fourth Award - General Motors ISEF

INVESTIGATING PLASMATUBULES IN TRANSFER CELLS OF PISUM SATIVUM L.

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Plasmatubules are tubular evaginations of the plasmalemma (cell wall) associated with sites where high solute flux occurs between apoplasts and symplasts. Plasmatubules of the scutellar epithelial cells of germinating barley have been examined following a variety of fixation methods. The purpose of this investigation was to observe the junctions between transfer cells of cross-sections of pea (Pisum Sativum L.) stems, and to locate plasmatubules. Pisum seeds were raised in germinating trays for 16 days at room temperature. The young leaflets, 3 cm in length, were harvested and the tissue was put directly into the fixative solution which consisted of 2.5% Glutaraldehyde, 1.5% Foralin, .05 molarity Sodium Cacodylate and a PH buffer of 7.0 for 2 hours at room temperature. Next, the tissue was washed in a .05 molarity Cacodylate and 7.0 PH buffer for 15 minutes at room temperature. The cross-sections were then put on slides, non-gritted and stained with Ethanolic Uranyl Acetate and Alkaline Lead Citrate. Final examination of the cross-sections was made with a Swift Phase Master Research Microscope at 60 K.V. of light. with which photomicrographs were taken of the tissue. Observation of the slides indicated that: plasmatubules do exist and are associated with phloem-type transfer cells and they are found at junctions of parenchyma and bundle sheath cells.

# DECOMPOSITION AND CHEMICAL CHANGES IN THE WOOD OF A PALM FOREST (AT EL YUNQUE)

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Earlier, I had estimated the volume, density, standing crop, and distribution of dead wood in a palm forest at El Yunque. I found five decomposition stages, a decrease in density, and changes in nutrient concentration through decomposition. In this study, I measured the rate of wood decomposition and accompaning nutrient change using 60 trees that had been tagged in 1946. I estimated the date of tree mortality using information from periodic inventories. Most trees died during hurricanes that passed through the forest in 1979. Each dead tree was cored every meter along the stem and the volume of the sample was measured. The density and nutrient concentration (N,P,K,Ca,Ash) were measured (about 6,400 results). The rate of wood decomposition (g/year) was estimated by multiplying volume (g/cm/3) minus the same calculations using values obtained for dead wood sampled in 1985-86. The amount left was divided by the time elapsed since the tree died. The rate in wood decomposition is discussed in terms of it's variance within the diferent species in the decomposition stages, showing that Prestoea montana increased, but Crecropia peltata and Sloanea berteriana decreased. Also, the rate of decomposition was analyzed in terms of it's variance with the wood density in decomposition stage 3.0, showing that the rate of decomposition decreased with the increased in the wood density. Decreased patterns were found in the different nutrient contents vs. the decomposition stages in the specie Prestoea montana. Nutrient analyses in other species are in process.

#Fourth Award - General Motors ISEF

THE EFFECT OF RADIATION ON BEAN SEEDS AND SEEDLINGS

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Purpose: To show how radiation affects bean seeds and seedlings
Procedures: Phase 1 (1984), germinating and dormant seeds were exposed to varying doses of radiation. Phase 2 (1985), the roots, stems, and terminal buds were exposed to 6000 rads of radiation. Phase 3 (1985-86), seedlings were exposed to 2000 and 6000 rads of radiation at different stages of growth. (7, 12, 21 days)
Data and Results: Phase 1: At low doses, stimulation occurs. The higher doses cause more inhibition of growth in a 2:1 ratio. Dry seeds take twice as much radiation as wet to get same results. Phase 2: The terminal bud is affected the most, roots second, and stem lastly. Phase 3: Seedlings most affected at periods of rapid growth, 8-16 days after planting. 6000 rads had a greater effect than 2000 rads.
Conclusion:
Phase 1. Wet seeds appear more sensitive to radiation than dry seeds in a 2:1 ratio. It appears to take twice as much radiation to wet seeds as dry seeds to cause similar results in stimulation and inhibition responses.
Phase 2. The terminal bud is the part of the plant most affected by radiation, then the roots, then stems. This may be due to rates of cell division and quantity of auxin in these parts.
Phase 3. As seedlings age, they appear to be most sensitive to radiation at the period of rapid growth, 8-16 days after planting.
Applications: In case of nuclear accident, knowledge of effects on plants is imperative.

DIFFERENTIATION OF CROWN GALL TUMORS INTO PLANT ORGANELLES THROUGH THE USE OF AUXINS AND CYTOKININS

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The purpose of this project was to determine the optimum ratio of cytokinin to auxin in the regenerating medium that produces the greatest percentage of plant organelles from the crown gall tumors. I hypothesized that as the level of cytokinin (benzyladenine) becomes greater in proportion to the level of auxin (napthalene acetic acid) in the media, a greater percentage of regenerated organelles will be produced up to a point where no regeneration will occur. The same principle is applicable when the hormone concentrations are reversed. My procedure was to grow tobacco plants in culture, inoculate them with Agrobacterium tumefaciens to produce the crown gall tumor, grow the tumors on Murashige and Skoogs salt base, and then on the same type of media, except with added hormones per liter in the following groups of fifteen: Benzyladenine Groups 1: .1 ml, 2: 1 ml, 3: 10 ml, 4: 100 ml, and Napthalene Acetic Acid Groups 5: .1 ml, 6: 1 ml, 7: 10 ml, 8: 100 ml. A group of fifteen more tumors was placed on new growth media to be used as a control. I found that regeneration of tumors into plant organelles didn't occur for any of the groups tested, probably because of the growth of molds, despite the use of antifungal and antibacterial agents in the media and when surfacesterilizing the tumors. I also found that as the concentration of phytohormones in the media increases, the amount of time between culture and first signs of mold growth decreases. It was also discovered that tobacco plants inoculated with Agrobacterium tumefaciens had a zero percent tumor generation rate.

CHEMISTRY

THE EFFECTS OF NATURAL PESTICIDES vs CHEMICAL PESTICIDES ON MOSQUITO LARVAE

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The purpose of this experiment was to determine if natural pesticides would work just as well as chemical pesticides on mosquito larvae. I thought this would be of interest because in the summertime our area is sprayed with chemical pesticides to control mosquito populations and I do not think these chemicals are healthy for us. As an alternative, I wanted to find a natural pesticide that would terminate the life of the mosquito larvae.

After placing ten (10) mosquito larvae in a 600 ml beaker, pesticides were administered into the beaker. The time was recorded relative to how long it took for the pesticide, either natural or chemical, to terminate the lives of all ten (10) mosquito larvae in the beaker. The results were then graphed.

The garlic powder, which I used as a natural pesticide, terminated the lives of the mosquito larvae in a sufficient amount of time. Therefore, I concluded that there must be a natural pesticide that can be used effectively without adding further chemicals to our environment.

CHARACTERIZATION OF TRANSIENT RESPONSES IN ION-SELECTIVE GLASS MEMBRANE ELECTRODES
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This research consisted of two stages, the first of which was conducted during the summer of 1985 and the second during the 1985-86 school year. The purpose of this research was to study various aspects of transient potential responses in ion-selective glass membrane electrodes, with emphasis during the second stage on determining whether they are caused by some diffusion process in the glass membrane, and if so, what process. Three main steps were used to determine whether the transient response to potassium in the sodium glass electrode is due to interactions in the glass membrane, or to the reference electrode or salt bridge. In the first two steps the electrode's transient response to potassium was observed with the sodium electrode. Third, the sodium electrode was replaced by a normal Ag/AgCl electrode. The results indicate that the glass membrane is responsible for the transient response. In a second experiment, the effect of the ion which the electrode is sensitive to upon the transient responses of another ion was tested. The sodium electrode's transient responses to a constant concentration of potassium were observed with varying concentrations of sodium. An inverse relationship between the size of transient response and the Na concentration was found. In Stage II, an entirely new experimental system has been designed and built, but due to longer time periods involved, no conclusive data have been observed at this time yet.

*MICELLE FORMATION AND FLOTATION WITH MIXED SURFACTANTS
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Surfactants are surface active molecules. The polar end of the surfactant is hydrophilic, while the non-polar hydrocarbon end is hydrophobic. Micelles are clusters of surfactant molecules which form at a certain concentration of surfactant, the critical micelle concentration (cmc). The initial purpose of this study was to determine the effect of a medium-chain alcohol (n-hexanol) on cooperative interactions leading to micelle formation in an ionic surfactant (sodium dodecyl sulfate-SDS). The cmc was determined by conductivity titrations. In an ionic solution, conductivity increases in direct proportion to the amount of surfactant being added until the cmc is reached. At this point, the formation of micelles decreases the number of charged carriers. The cmc was determined from a graph of conductivity of solution versus concentration of surfactant in the solution. It was found that the addition of n-hexanol reduced the amount of SDS required to reach the cmc. The mathematical relationship between the cmc and the percent saturation of n-hexanol solution was most closely approximated by a third degree polynomial. After it was determined that n-hexanol allows micelles to form at a lower concentration of SDS, flotation runs with SDS and n-hexanol were made in order to show the practical application of this research. Flotation is the separation of various types of particles by the bubbling of a gas through a solution. In flotation, micelle-like structures form around the particles being removed. After successfully proving that n-hexanol can be used as a surfactant extender in the flotation process, it was calculated that flotation with SDS alone is nearly four (4) times more expensive.

*First Award - United States Army
Second Award - General Motors ISEF

THE RELATION BETWEEN THE FLUORESCENCE AND DEGRADATION OF RIBOFLAVIN

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From research conducted in previous projects concluded that riboflavin (vitamin B2) degrades and fluoresces when exposed to light. The purpose of this year's project was to determin if there is a connection between the two actions. The pH of several riboflavin samples was varied - which influenced the riboflavin's fluorescence - and 95% of the fluorescence of another sample was quenched by using potassium iodide. The samples were then placed in sunlight and their degradation was measured. To measure the amount of riboflavin left in the samples after exposure, I used a spectrophotometer to measure the percent transmission of light through the samples. I concluded that:

1. Riboflavin in solution degrades most quickly at pH 7.
2. Riboflavin degrades more slowly at low and high pH levels. The intensity of fluorescence as well was lower at these levels.
3. The riboflavin sample with its fluorescence quenched degraded much more slowly than the control sample. I concluded, therefore, that riboflavin samples with the lowest intensity of fluorescence will degrade the slowest.

ETHYL ALCOHOL, AZEOTROPES AND THE KINETIC THEORY

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The project shows that an azeotrope is formed between ethanol and water and explains why the boiling point of the azeotropic mixture is lower than the boiling point of H_2O or ethanol.

A COMPUTER MODEL OF CARBON CHAIN SYNTHESIS

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Three-dimensional conformations of polymer molecules were studied by computer simulation of the synthesis of carbon atom chains with bond angles of 109.5°, bond lengths of 1.54Å, and free rotation about C-C bonds. Vector analysis and a random number generator were used to locate the position of each atom in the sequence. "Foldback" is defined to occur when the position chosen for an atom is within 1.54Å from any previous atom in the chain. Foldback was characterized in terms of chain length at the occurrence of foldback and foldback loop length. Graphs of the data yielded the following conclusions: (1) The smallest number of bonds in a loop is 5; this is also the most common loop length. (2) Loop length frequency decreases roughly exponentially with increasing loop length. (3) Foldback occurs most frequently at shorter chain lengths, generally decreasing with increasing chain length.

More recent work involved surmounting the foldback problem and calculating radii of gyration and end-to-end distances. These were correlated with the number of atoms in the chain.

#First Award - United States Navy - Office of Naval Research
Third Award - General Motors ISEF

*ECONOMICAL AND PRACTICAL FREEZE PROTECTORS FOR TOMATO PLANTS, A SECOND YEAR STUDY.

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Freezes kill multi-million doller vegetable crops in S. Fla. every year. PURPOSE: To find an economical and practical freeze protector. YEAR ONE: Citrus peel solution protected tomato plants from freezing. YEAR TWO: Chemical analysis & experimental research were used to determine which elements in citrus peel solution were preventing freeze damage. Major elements used were magnesium, copper, iron, calcium potassium, ammonium oxalate & ammonium hydroxide in solution strengths of 1 tablespoon per 2 liters of water. Tomato plants were used as test plants. Plants were first bested for chemical sensitivity, then groups of plants were sprayed with a chemical & frozen for varying lengths of time using a domestic freezer and freezing cold fronts that went through the Lee County area. Temperatures and weather conditions were carefully recorded during freezes. Plant analysis were made daily for 5 consecutive days following each freeze. Results of research as follows: Ammonium hydroxide, ammonium oxalate, calcium oxide & iron gluconate plants froze and died. Copper II oxide and potassium oxide plants were damaged on leaves and upper stems but lived & resprouted. Magnesium oxide protected best. While other plants were white with frost, the Magnesium plants had dew-like drops of water on the leaves instead. There was no freeze damage to these plants. Domestic freezer temps. could not be controlled well enough for proper experimentation. During natural freezes & frosts, it was discovered that spraying, rather than pouring chemicals on plants worked better. Also it appears that chemicals should remain on plants during the daily warm-up. Further study will be made in both the areas of application and warm-up.

*Honorable Mention - American Chemical Society
Honorable Mention - American Intellectual Property Law Association

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A COMPARATIVE STUDY ON THE CHEMICAL AND BACTERIOLOGICAL PHASES IN THE PROCESSING OF RAW AND PASTEURIZED MILK FROM SOME DAIRIES IN PUERTO RICO

Vásquez, Francis, C.R.O.E.M. H.S., Mayaguez, PR 00709;
Cerro Las Mesas, Mayaguez, PR 00709.

My scientific investigation deals with a study on the chemical and bacteriological phases in the processing of raw and pasteurized milk from some airies in Puerto Rico. I did extensive laboratory research on the environmental factors affecting milk's physical and molecular chemistry using the facilities of the Puerto Rico Dairy Products Association. My study involved several quality control tests to determine Acidity, Lactometry and Total Solid Percentage for taste, odor and appearance. I also tested for the presence of bacterias and antibiotics present in the samples studied. Other data was collected on temperature and phosphatase.

My study reveals that consumers are getting milk with a 71% of quality and this condition is quite acceptable for consumers. I determined that environmental factors were the cause for the 29% contamination of the product. I found out that the milk samples studied contained yeast cells, Staphilococcus and Bacillus. The samples also contained antibiotics mainly Penicillum that was probably used for treatment of cows.

I hope this research help in bringing out to public attention the great necesity of improving milk's quality for human consumption.

# ROCHELLE SALT: MORPHOLOGICAL AND OPTICAL EFFECTS OF METAL IMPURITIES

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Crystals of pure Rochelle Salt (Sodium Potassium Tartrate) normally grow with six pairs of faces (parallel to the long axis) in the orthorhombic crystal structure. Holden and Morrison report in their book Crystals and Crystal Growing that it is possible to change the morphology of these crystals by the addition of copper acetate monohydrate. By eliminating just the copper and then the acetate, and by substituting other ++ ions for the Cu++ in an aqueous growth solution, it is possible to determine the cause of these morphological deviations and also whether these qualities are limited to copper.

By adding several different metal ion impurities to growing solutions of Rochelle Salt, and by adding acetic acid, it is possible to determine whether the morphology changes are caused by the metal ions or the acetate ion, and by using a laser reflection apparatus it is possible to accurately determine which faces are being suppressed. Also, by using flame spectroscopy, optical activity, density, and X-Ray diffraction patterns it is possible to determine if any of the impurities are incorporated in the solid.

The results of these experiments show that copper is totally responsible for the change in morphology of Rochelle Salt when grown from a copper acetate solution, and also that other 2+ metal ions are able to produce similar effects. It is proposed that these morphological modifications are due to the preferential adsorption of metal ions on selected faces, which causes a substantial decrease in growth rate.

#First Award - American Chemical Society
First Award - General Motors ISEF
Scholarship - United States Marine Corps
Second Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society

SILICON PHOTOELECTROCHEMICAL CELLS, "Solar Splitting of Water"

Ohlhausen, James (Tony) Anthony, Abilene H. S., Abilene, TX 79603
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Because of recent and projected energy shortages, hydrogen fuel has become increasingly attractive. Silicon and water, readily available materials, can be used in photoelectrochemical cells to produce this efficient, clean fuel.

Two major types of cells were investigated in this project.

1) A two solution apparatus with Pt-plated n-silicon immersed in 3M HCl and Pt-plated p-silicon immersed in 3M NaOH was utilized. Production of H_2 was noted after illumination of the n-silicon.
2) A reaction vessel with removable electrodes, and a stationary Pt counter electrode was constructed. Several types of Si electrodes were tested including Pt and non-Pt plated n and p type silicon wafers as well as commercial solar cells and silicon wafers coated with other catalytic substances. Undoped wafers regardless of coatings did not produce H_2. Silicon solar cells produced H_2 only after illumination and the application of a 1 v., 50 mA. potential. The effects of a two vessel series system were investigated as well as the effects of catalytic agents on the n and p type silicon.

Hydrogen production in all experimental cells was small; however, the results indicated that photoelectrochemical production of H_2 might eventually become a viable source of renewable energy.

#Scholarship - Ohio State University
Honorable Mention - American Chemical Society

NUCLEAR WASTE LEAKAGE: A "COMPLEX" PROBLEM

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A part of the nuclear waste disposal plan on the Hanford, WA site was tested. The final stage of the barrier system in the repository consists of a bentonite clay backfill around the waste cannisters. It was chosen partly for its sorbent properties. On the Hanford site there exists an organic material known as fulvic acid that has leached from soil humus and seeped via groundwater down to repository level. Fulvic acid can form complexes with metal ions such as uranium. It has been suggested that this process could enhance the leaching of uranium from bentonite.

This possibility was tested by absorbing a .005 molar solution of uranyl acetate in 1 gram samples of bentonite. The bentonite was then leached with water and also with fulvic acid solutions. The uranium content of the extracts was next measured using several 10-minute counts on a Geiger counter. Results were compared with a calibration curve.

The data showed that the fulvic acid solution allowed more uranium to be extracted from the bentonite than when water alone was used. The average amount for water-leaching showed approximately 8 per cent of the uranium removed from the bentonite. The average amount in the fulvic acid extract showed approximately 37 per cent had been leached from the bentonite.

I conclude that the presence of fulvic acid on the Hanford repository site may lead to far greater amounts of uranium released to the environment than was previously expected.

#Third Award - Association for Women Geoscientists Foundation
Fourth Award - General Motors ISEF
Honorable Mention - American Chemical Society

# THE EFFECTS OF ELECTRIC FIELDS ON CRYSTALLIZATION

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The purpose of this continuing research project is to determine both the physical and chemical changes, if any, present in polar-covalent phenyl salicylate crystals grown within an electric field. These results are then used to determine general hypotheses to account for the effect of electric fields on the crystallization of all polar-covalent compounds.

Phenyl salicylate crystals were melted and placed between two clean glass slides. The slides were compressed, forming a layer of molten crystal approximately .2mm thick. The molten crystal was allowed to solidify, then remelted and placed within an electric field. After the sample had completely crystallized within the field, it was placed in a polarized light viewer and the image recorded on videotape. The images of samples grown with and without an electric field were then compared to look for structural changes in crystal lattice. Chemical changes in the crystallization process were tested by recording the time of crystallization of the samples.

The experimentation with phenyl salicylate has yielded two general hypotheses:

1. An electric field of less strength than approximately 28,000 Volts/cm has no effect on crystal structure.
2. An electric field has an effect on the time of crystallization.

#Alternate to Scholarship - Ohio State University

# THE USE OF pH SENSITIVE POLYMERS IN THE DEVELOPMENT OF AN ACID CONTROLLED MEMBRANE

Holy, Timothy E., Upper Dublin H.S., Fort Washington, PA 19034;
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Polymers are used as coatings in a great number of applications. My research was devoted to creating a new type of polymeric coating, one which responds to its environment. I proposed to create a membrane that selectively responds to acid.

After researching the topic, I decided that the best way to accomplish this was to have the polymer expand in acid, becoming less dense and thus more permeable. I found that polymers containing nitrogen (because of its extra pair of electrons) satisfied these conditions very well.

To make this coating, I polymerized 4-vinylpyridine around limestone using the solution process. I then tested the capsules by placing them in solutions of varying pH, from fairly acidic to fairly basic. I found that in acidic solutions the polymer becomes porous and the limestone raises the pH of the solution. However, in basic solutions it is inert and forms a shield around the limestone.

Such a coating is very valuable, with applications in medicine, chemistry, and the environment. Medicines could be coated with this material to provide specific, localized treatment. This polymer could be used in chemistry, with applications ranging from a viscosity controller to acid-based column chromotography. In the environment, coated limestone could be used to control acid rain; when the lakes became too acidic, the coating would open and neutralize the acid, but not at any other time.

#Fourth Award - General Motors ISEF

AN INVESTIGATIVE STUDY INTO THE THERMAL DECOMPOSITION OF ASPARTAME

Oelhafen, Richard J., Providence Day School, Charlotte, NC 28226
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Prolonged exposure to high temperatures causes significant breakdown of the artificial sweetner aspartame. The thermal decomposition of aspartame is controlled by two variables - temperature and time. The purpose of this study was to determine the length of time required to thermally decompose aspartame. All data was obtained at the boiling point of ethanol with varying reaction times.

Aspartame, more formally known as 1 - methyl N - L - α - aspartyl - L - phenylaline ($C_{14}H_{18}N_2O_5$) is an organic compound metabilized in the body as a protein. Proteins are composed of amino acids bonded in polypeptide chains. Amino acid thin-layer chromatography was chosen as the method for measuring the amount of decomposition. Amino acid thin-layer chromatography was done with cellulose absorbent strips, and a developing solvent. Upon the completion of each trial, thin-layer chromatograms were developed. These chromatograms served as indicators of the thermal decomposition of aspartame. With reaction times less than 45 minutes, no decomposition occurred. However, at the 60, 90, and 120 minutes reaction times, thermal decomposition was evident. In conclusion, aspartame exposed to an 80°C temperature for an excess of 45 minutes will decompose.

#A QUANTITATIVE ANALYSIS OF ELECTRODEPOSITION AND ELECTROSTATIC-DEPOSITION

Hoffman, Ken, Wheeling Park H.S., Wheeling, WV 26003;
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The objective of this project was to build an electrostatic Van de Graaff Generator to provide an adequate and constant source of static electricity which could be used as a source of energy in the electrostaticdeposition process. A six volt battery and six and twelve volt DC current were also used as alternative sources of energy. The experiments were conducted maintaining the same controls over a period of long-term study. Data were recorded and charts were made for comparisons. The hypothesis was that the electrostaticdeposition process may be superior to the other energy sources.

Experiments were conducted to investigate electrolysis and to test the process of copperplating various types of materials. The experiments were re-evaluated, re-organized and repeated using tighter controls. After the adjustments were made, the process was repeated with the copper sulfate bath heated to 80 degrees.

The experiments of the electrodeposition/electrostaticdeposition processes were conducted using various power sources, various metals, and various plating times. A quantitative analysis study was done comparing weight and thickness. A top loader scale and micrometer were used for precise and accurate data collection.

It was observed through this study between weight and thickness that some metals gain the same amount of weight but the thickness of the copperplating may vary greatly. It was concluded that copper bonds tighter to some metals than others providing the better coat, and that humidity has a definite effect on the electrostaticdeposition process. It is felt that, in humidity controlled environments, the electrostaticdeposition process may prove beneficial to industry.

#Honorable Mention - American Chemical Society

ISOMERIZATION OF A CHROMIUM COMPLEX

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Sodium trans-bis(oxalato)diaquochromate(III) is a chromium complex that is used in industry, and some similar complexes are believed to be used in the body. Relatively little is known about this complex and its characteristics.

The purpose of the first stage of this experiment was to determine how the isomerization of this complex is affected by the pH of the solution in which it is dissolved.

This was done by creating solutions at various pH's, dissolving the chromium complex in the solution, and then recording the absorbance as a function of time. By mathematically manipulating the data, the rate constant of isomerization at a given pH could be obtained.

It was found that the rate of isomerization increases as the solution becomes more basic. This is thought to be caused by the formation of trans-bis(oxalato)hydroxyaquochromate(III) (I) and trans-bis(oxalato)dihydroxychromate(III) (II). Between pH 7.1 and pH 7.6, the complex was primarily species (I) while at pH 10.9 and higher, the complex was primarily species (II).

This data, when coupled with rate constant data obtained at different temperatures, can provide information about the energetics of this reaction. The second stage of this experiment will attempt to determine the activation parameters for the reaction of species (I) and (II).

#OSCILLATING CHEMICAL REACTIONS

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PURPOSE: The purpose of the project was to examine and study the phenomenon that certain closed chemical systems oscillate colors and visibly organize into a spiral wave.
HYPOTHESIS: The mixture of certain chemicals in a closed system where temperature and pressure are held constant will result in oscillations of definite color change and organization in a spiral wave.
PROCEDURE: Multiple initial attempts to create a cerium-based oscillator resulted in a full application of experimental tests for determination of useful molar concentration ranges, examination of bulk color changes in test tubes, and examination of spiral wave shapes and velocities in petri dishes. The reactants for the oscillator included cerium ammonium nitrate, malonic acid, sulfuric acid, phenanthroline ferrous sulfate and potassium bromate.
RESULTS: The net chemical reaction taking place appeared to be the oxidation of malonic acid by bromate with a cerium ion catalyst. The band wave rate of propagation was most affected by the concentration of cerium ammonium nitrate indicating it was the main reactant.
ANALYSIS: The mixture of certain chemicals in a closed system definitely resulted in oscillating reactions as verified by spectrophotometric analysis and by comparisons of spiral wave propagation velocities and molar concentrations. However, this complex phenomenon is still not fully understood as the color patterns are hard to observe, and mathematical equations are far from being understood.

#First Award - Eastman Kodak Company
Alternate to Scholarship - Ohio State University
Fourth Award - General Motors ISEF

HYDROGEN : A SEARCH FOR INCREASED PRODUCTION YIELD

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The purpose of this project is to investigate the effects of electrode composition, surface area of the electrodes, electrolyte composition, and temperature on the amount of hydrogen liberated in electrolysis. Since hydrogen can be extracted from water, it is an almost inexhaustible fuel source. Electrolysis is a very inefficient procedure for producing hydrogen. This project is based on the need for more research into hydrogen production through more efficient electrolysis.

In this study the electrodes tin, aluminum, and copper were tested with the electrolytes hydrochloric acid, sulfuric acid, sodium chloride, and sodium hydroxide at 5°C, 20°C, and 35°C. The electrodes and electrolytes used contained the same number of moles and were compared accordingly.

It was found that the volume of hydrogen produced varied directly with the type of electrode, electrolyte, surface area of the electrode, and temperature used. The quantity of hydrogen produced gradually increased as the temperature increased using hydrochloric acid and all electrodes. Both the copper and aluminum electrodes produced volumes of hydrogen that showed a considerable increase when tested with sodium chloride as the temperature increased. Aluminum electrodes in the sodium chloride solution at 35°C produced the greatest quantity of hydrogen over all other combinations tested. All other electrodes and electrolytes tested liberated volumes of hydrogen that varied with the surface area of the electrodes and the temperature.

# THE PRODUCTION OF A CLEANER COAL GAS

Morrissette, Willie J., Whitney Young H.S., Chicago, Ill. 60607
8118 So. Yale St., Chicago, Ill. 60620.

Purpose: To develop an economical and technically efficient method for the removal of sulfur pollutants from coal flue gas by reacting coal flue gas with hydrogen peroxide so that the amounts of sulfur pollutants, mainly SO_2, will be reduced.
Procedure: The method is based on the reaction of hydrogen peroxide and sulfur dioxide to produce sulfuric acid. The results of the project will be based on titration of the hydroxide peroxide solution and gas chromatography analysis of the gas.
Conclusion: It was concluded that a cleaner coal flue gas could be produced by reacting the gas with high concentration of hydrogen peroxide at lower temperatures.

#Second Award - United States Air Force
Third Award - General Motors ISEF
Honorable Mention - American Chemical Society

# NITROGEN DIOXIDE: ENHANCEMENT IN SULFIDATION OF COPPER

Huynh, Hung T., Glendale High School
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Corrosion is the destruction of metals as the result of reactions with the elements in the environment. Hydrogen sulfide is known to be a very corrosive agent. It reacts with metals and forms metal sulfides. Ozone and photons are found to be enhancers of such reactions. The objective of this project was to determine whether nitrogen dioxide can enhance the sulfidation of copper. The experiment was performed using two home built humidity cabinets. Two sets of data were collected. One with the copper exposed to just hydrogen sulfide, the other with the copper exposed to hydrogen sulfide and nitrogen dioxide. The results were graphed and compared. They indicated that nitrogen dioxide is an enhancer of corrosion. Furhter study showed that nitrogen dioxide quadruples the corrosion rate of copper when it is exposed to atmospheric hydrogen sulfide.

#First Award - United States Air Force

# A NUMERICAL EXPERIMENT: THE VIBRATIONS AND ROTATIONS OF WATER

Kolaja, Thomas A., Morgantown High School, Morgantown, WV 26505;
674 Manor Place, Morgantown, WV 26505.

A classical model of the water molecule is an oxygen, a big ball, connected by weightless springs to the hydrogens, two small balls. When the molecule is excited, the springs between the oxygen and the two hydrogens vibrate. As they vibrate the molecule wobbles. This research deals with investigating the speed of this wobble. It has been found that the behavior of the wobble, for all low and medium energy vibrations, can be modeled with an equation of the following form: $f = a \cos \theta_1 + b \cos \theta_2 + c \sin(\theta_1 - \theta_2)$. The results will help predict what effect rotating the molecule will have on the vibrating oxygen-hydrogen bonds.

#Scholarship - Ohio State University

#NUTRASWEET^{TM} IN DIET SODA: A STUDY OF STORAGE TEMPERATURE

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One of the new commercial chemical sweeteners is L-Aspartyl-L-Phenylalanine Methyl Esther. Known by its trade names Aspartame and NutraSweet, it has become the component of many low-calorie foods. There has been some evidence that this compound breaks down in solution form. The experiment was designed to study the breakdown that occurred in diet soda samples stored at 5, 15, 25, and 35 degrees Celcius for a trial period of ten weeks.

The quantity of Aspartame was checked using a High Performance Liquid Chromatograph (HPLC). The Aspartame peaks produced were measured using triangulation and Heron's Theorem to calculate the area. The areas were then compared to a standard of pure Asparatme to determine the quantity.

The Aspartame quantities were found to decrease significantly, with a greater decrease occurring at higher temperatures. The values were found to be in a direct logarithmic relationship. The data also led to a formula to predict the slope of the logarithmic line at any temperature. Using this formula it was possible to produce data that closely approximated the experimental data. Testing this formula in more detail would be needed for a better determination of its validity. It would also be useful to identify the decomposition products to determine the long- term safety of Aspartame products.

#Fourth Award - General Motors ISEF

SPECTROSCOPIC CHARACTERIZATION OF EPOXY-AMINE SYSTEMS

Czerniawski, Debbi A., Magnificat H.S., Rocky River, OH 44116
15806 Normandy Avenue, Cleveland, OH 44111

The polymer, an epoxy-amine system, is composed of the epoxy Tetraglycidyl Diamino-Diphenyl Methane (TGDDM) and the amine Diamino-Diphenyl Sulphone (DDS) whose concentration ranges from 10 to 40 percent to relative amounts of TGDDM. The Fourier Transform Infrared Spectrometer (FTIR) was used to produce readable frequency spectra. Qualitative analysis was achieved by comparison of the various system and component monomer spectra with attention to the peaks produced by primary amine, epoxide and ether groups. Quantitative analysis was accomodated by two aromatic rings found in the center of each monomer. These are stable, generally non-reactive and can be used as reference points in normalization for subtraction of spectra to find exact loss or gain. TGDDM and DDS are tetrafunctional monomers. TGDDM has epoxies at its reactive sites which decrease with the extent of reaction. These have no preference in reactivity and bond randomly. The DDS primary amines are very reactive more so than its secondary amines which have a reactivity ratio of only approximately 0.20. It is seen in the qualitative comparison that there is a definite decrease in both the primary amine and the epoxy as the DDS concentration increases. As the monomers reacted in polymerization, the epoxides at the reactive sites of the TGDDM and the primary amine at the reactive sites of the DDS disappeared. The amounts of ether groups, products of a side reaction with DDS, increased with DDS.

POLYMER DEGRADATION

Daley, Michael A., Taylorville High School, Taylorville, IL 62568
300 East Adams, Taylorville, IL 62568

In Phase I of my project, my purpose was to determine the effect of acid rain on pink marble, mahogany granite, southern granite, white marble, sandstone, limestone, chalk limestone, and greywacke sandstone.

I exposed the above stones to solutions of nitric acid, sulfuric acid, carbonic acid, and a mixture of the three acids.

I concluded that some stones were more resistant to one type of acid than to another acid. In order from most to least resistant in Nitric acid were white marble, mahogany granite, southern granite, pink marble, limestone, sandstone, greywacke sandstone and chalk limestone. In sulfuric acid from most to least resistant were mahogany granite, pink marble, sandstone, white marble, southern granite, greywacke sandstone, limestone, and chalk limestone. In carbonic acid the order of resistance was white marble, sandstone, pink marble, mahogany granite, limestone, greywacke sandstone, southern granite, and chalk limestone. In combination acid the resistance from most to least was pink marble, white marble, mahogany granite, limestone, southern granite, greywacke sandstone, sandstone, and chalk limestone.

In Phase II of my project, my purpose was to test the effect of acid rain on stones that had been sealed with polymers.

I coated white, pink, and black marble with Walmart indoor-outdoor spray paint, Ace 127 clear lacquer, 7701 Rust-oleum clear seal, Dutchboy crystalloid varnish, UGL Drylock concrete protector, and Thompson's waterseal. Next the marble was exposed to a combination solution made of nitric, sulfuric, and carbonic acid with a pH of 0.9.

These commercial sealers were not completely effective in stopping acid rain deterioration; although, they did stop it for a short time.

SEEDING MATERIALS FOR A MAGNETOHYDRODYNAMIC GENERATOR

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A magetohydrodynamic (MHD) generator consists of stream of ionized gas moving across magetic lines of force perpendicular to electrodes. Thee lines of force deflect the charged particles toward the electrode, thus generating electricity.

In order to provide for charged paticles in the gas, the gas is heated and seeded with an easily ionized material. The purpose of this project was to test which material would be most effective as seed.

A model MHD generator was constructed. However, direct measurements of the voltage produced were swamped by the thermoelectricity. Therefore, mesurements were made of resistivity of seeded gas, for as the resistivity of seeded gas decrease the effectiveness of the seed increases.

It was found that the most effective seeds consisted of those producing cations found in the lower left hand side of the periodic table.

HOW TO MEASURE BILIARY β-GLUCURONIDASE ACTIVITY DEVOID OF INTRINSIC INTERFERENCE?

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Human bile contains β-glucuronidase. Its role in the development of pigment gallstones is currently under investigation. However, measurement of β-glucuronidase activity is interfered by the bile acids and conjugated bilirubin present in the bile. The purpose of this study is to develop a standard method for preparing the bile for β-glucuronidase determination by eliminating such intrinsic interfering factors. The bile acids and conjugated bilirubin in their purified solutions and in the diluted gallbladder biles were extracted with cholestyramine, an anion exchange resin, or tetrahexylammonium chloride (THAC), an oil-soluble quaternary amine, in either chloroform or ethyl acetate. Complete extraction could be achieved by large dose or by repeated extraction in all cases. A portion of the enzyme was, however, precipitated with cholestyramine or denatured by chloroform resulting in a much lower activity. The enzyme activity was, on the other hand, not altered by ethyl acetate. Therefore, THAC in ethyl acetate was adopted in the following extraction procedure: The gallbladder bile was diluted 5- to 10-fold with water which was then extracted with equal volume of 10 mM THAC in ethyl acetate, followed by determination of the maximal velocity of the enzyme by kinetic method employing phenolphthalein glucuronide as the substrate. The activity measured represented the true activity of the enzyme in the bile for the recovery of the activity of the enzyme added to the bile was practically complete. The average activity in 20 gallbladder biles without gallstones was 136.6 ± 77.0 nmol/min/ml (mean ± S.D.). The activity was specific for β-glucuronidase for it could be inhibited totally by glucaro-1,4-lactone.

TINY BUBBLES- CO_2 PRODUCTION BY A CHEMICAL (SODIUM BICARBONATE) AND FROM A LIVING ORGANISM (YEAST)

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The purpose of the project was to learn if baking powder, baking soda or yeast produced more CO_2 gas when mixed with certain liquids at different temperatures. When sodium bicarbonate is mixed with additives containing acid, it reacts by producing carbon dioxide. Yeast produces CO_2 when it is mixed with liquids containing sugar and is warmed so it becomes active.

I mixed a measured amount of baking powder, baking soda, or yeast with a measured amount of liquid additive (grape juice, lemon juice, milk, vegetable oil, orange juice, vinegar, distilled water or well water). I did these experiments at 33°F., 78°F., and 120°F. (Yeast was mixed with grape juice, lemon juice, milk, orange juice, and vinegar at 78°F. only.) The amount of CO_2 produced in a 40 minute period was measured with a device made of glass containers and plastic tubing. The cubic inches were recorded. The experiments were repeated and the gas was bubbled into water containing bromo thymol blue to test the pH level, and was also 'poured' over a flame to help determine if the gas was indeed CO_2. The experiments showed that baking soda, when added to 33°F. vinegar, produced the most CO_2. When comparing all the results, baking powder, which contains calcium acid phosphate, produced the best in many instances. Yeast produced the best with grape juice.

I would like to conduct further studies with CO_2, this time seeing if the health of a plant is affected by exposure to different levels of CO_2.

EVOLUTION OF HYDROGEN BY MEANS OF PHOTOELECTROLYSIS

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Due to the detrimental effects to the environment from the use of hydrocarbons as an energy source, an alternative source of energy is being sought which is plentiful, inexpensive, and environmentally safe. Hydrogen would be a sound alternative if not for its scarcity in the uncombined state and the expense necessary to produce the gas in large quantities using conventional methods.

This project was an effort to improve upon a device developed at the University of California at Berkely. This device consisted of an iron oxide diode countered by a platinum electrode. The researcher has eliminated the platinum electrode and extended the diode to opposing half cells in order to lower the cost of the system. This project's purpose is to evaluate the feasibility of this new photoelectric cell to evolve hydrogen on a large scale basis. The amount of hydrogen produced in a specific span of time was the determining factor of feasibility.

In the trials performed, the greatest amount of hydrogen produced was observed within the first hour of operation, averaging 9.3×10^{-6} moles of hydrogen. After the elapse of four hours, no further production was noted. The average total produced after this time was 2.5×10^{-5} moles. It can be concluded from the data obtained that the elimination of the platinum counter electrode by extending the iron oxide diode to separate half cells has not only cut down on the cost of manufacturing such a cell, but has also increased the efficiency of the system,based upon the data collected by C. Leygraf, M. Hendewerk, and G.A. Somorjai at the University of California.

A STUDY ON THE ALLELOPATHIC EFFECTS OF SOME MEDICINAL PLANTS ON THE GERMINATION AND DEVELOPMENT OF ZEA MAYS, CAJANUS CAJANS AND PHASEOULUS VULGARIS

Feliciano, Vilma L., C.R.O.E.M. H.S., Mayaguez, PR 00709;
Cerro Las Mesas, Mayaguez, PR 00709.

The main objective of my research was to determine the effects of allelopathic agents contained in some medicinal plants widely used in Puerto Rico on the processes of germination and development of the plants of Zea mays, Cajanus cajans and Phaseoulus vulgaris. I used these seeds because they are typical elements in the daily diet in our Island, and are fast growing plants.

After extensive reading and interviewing on the subject, I selected nine (9) medicinal plants for my scientific investigation. I took leaves from each specie and placed them individually in each germination chamber that was prepared using Petri dishes and wet paper towel. I added the seeds and observed them daily checking any changes. I repeated the procedure but using .01% and .0001% concentrations of leaves extracts. All observations were recorded and analyzed. I prepared graphs and photographed to study relationships and effects. I studied soil's pH in which plants grew in order to determine the relation, if any, affecting the results. The most significant findings of this study reveal that allelopathic agents present in this plants reduce soil's pH, that these are apparently souble in water although volatile. I also determined that at a lower concentration of leaves extracts in water, the greater the retarding effect in germination is observed. Allelopathic agents seem to affect more the growth and development of monocotyledoneous plants.

A TWO YEAR INVESTIGATION OF THE $CoCl_2$-CATALYZED REACTION BETWEEN TARTRATE ION AND H_2O_2

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When $CoCl_2$, sodium potassium tartrate ($NaKC_4H_4O_6$) and H_2O_2 are mixed together a vigorous reaction occurs. The color of the solution changes from pink to a dark green intermediate (thought to be the activated complex) and then back to the original pink color. Various differing theories have been suggested in regard to the initial reaction complex formed.

Phase I of this investigation found the reaction rate to be temperature and pH dependent (fast at pH 8.5, slow at pH 5). The visible spectra showed the presence of two distinct chemical species. Iron III and Copper II were found to have catalytic activity similar to that of Cobalt II in the tartrate-H_2O_2 reaction.

Phase II of this investigation has sought to discover more information on the kinetics and stoichiometry of the cobalt-catalyzed reaction. The rate of the reaction at a constant temperature was found to be first order with respect to Cobalt II. The stoichiometric ratio between H_2O_2 and tartrate ion was found to be 7.3 : 1, instead of the theoretical ratio of 5 : 1. From studies of the CO_2 evolved, it was concluded that the tartrate ion was not completely oxidized to CO_2. As a result of the above investigations, a reaction mechanism was proposed.

#Third Award - American Chemical Society
Third Award - General Motors ISEF

THE DETERMINATION OF METAL IONS IN SOLUTION USING CHEMILUMINESCENCE

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Chemiluminescence occurs when chemicals are combined to produce light without producing heat. This phenomena is useful for determining concentrations of metal ions. Other researchers have had limited success determining concentrations of solutions with one ion. My method involves the development of a technique which allows the determination of the concentrations of all ions in a solution which contains many ions. In my experiments the chemiluminescent reactions involve luminol, hydrogen peroxide, and a metal catalyst in alkaline solution. Data were recorded using a flow system apparatus. Light intensities were recorded using a photodiode connected to an Atari Personal Computer. Data were then analyzed using the computer. Solutions of some metal ions produced curves of light intensity versus time which decayed as time progressed and the ion was oxidized. Although the reaction is first order, the light decay is not. The metal ions absorb energy from some of the excited aminophthalate ions produced. The absorption varies with time as the original ion is oxidized. I determined an equation for light intensity versus time for the reaction, and from this equation constants for specific metal ions were determined. These constants allow the determination of concentrations of unknown solutions. Some metal ions act as true catalysts in the reaction, producing a different light emission curve. I have determined the equations for these ions and their ion-dependent constants. Equations for both kinds of ions may be combined to allow the determination of several ions in one solution.

A THREE YEAR STUDY OF THE RATE OF DETERIORATION OF VITAMIN C: USE OF A NEW METHOD OF ANALYSIS AND SEARCH FOR AN ANTIOXIDANT TO RETARD THE RATE

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The purpose of this, the third year's research, was to test different antioxidants to discover if they retard the deterioration rate of vitamin C, and if one or more did retard the rate, to test it in actual juice samples. Four antioxidants were tested in three different concentrations using methods developed in the second year's research. The antioxidants tested were BHT (butylated hydroxytoluene), BHA (butylated hydroxyanisole), n-propyl gallate, and vitamin E. Only vitamin E showed highly positive results. BHA had a small positive effect while BHT actually accelerated the deterioration rate. It was decided that the vitamin E would be used in the test with juice samples because it produced the greatest retardation effect. It was used in the greatest possible concentration (0.1% or 1g/L) in three different brands and types of juices that had no previously added preservatives. The juices were "Tropicana", a frozen concentrate; "Cost Cutter", canned from frozen concentrate; and "Hi-C", a canned breakfast drink. All juices showed retarded deterioration rates when compared to controls of the same sample. This proves that an antioxidant can retard the deterioration rate of vitamin C in orange juice samples. However, of the Food and Drug Administration approved antioxidants tested, only vitamin E has the retarding effect and BHT should not be used because it increases the rate of deterioration.

#Third Award - General Motors ISEF
Fourth Award - American Chemical Society

# PHOTODEGRATION OF POLYCHLORINATED BIPHENYLS

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1071 Piedmont Drive, Sacramento, CA 95822

Polychlorinated Biphenyls (PCBs) are widely used as coolant in electrical transformers and other applictions. They are found to be toxic and very wide spread in the environment and the ecosystem. The disposing of transformer oil that contains PCB becomes a major problem. Since the government considers burying PCB as undersireable, and there are many air pollution problems associated with the combustion method, such as incomplete combustion and production of toxic reaction products. In this experiment, a model compound 3,3-dichlorobiphenyl (DCBP) was irradiated with ultraviolet light generated with a mercury vapor lamp (254nm) and with sunlamps which have the same UV spectrum as natural sunlight. Gas chromatographic analysis of the irradiated solutions showed 3,3-DCBP was degraded by both the mercury vapor light and the simulated sunlight. Subsquent irradiation of an actual commercial PCB mixture (Arochlor 1232) with the simulated sunlight also showed marked changes in the components. The results indicated that contributes to the environmental degradation and compositional changes of PCBS.

#Fourth Award - General Motors ISEF

# EXTRACTION AND ANALYSIS OF OIL FROM Euphorbia marginata

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For the past ten years, researchers have studied the use of plants from the family Euphorbiaeceae as a promising future energy source. This family uniquely processes its carbohydrates into hydrocarbons, the main component of petroleum. In this study, data was collected on the plant Euphorbia marginata and compared to data from a similar study conducted by Dr. Melvin Calvin, U.C. Berkeley, on the Euphorbia lathyris. The relationships between the two plants helped determine the potential of the E. marginata as an additional petroleum source. A sample of the oil was extracted with an average yield of 11%, which results in an average of 3.76 barrels per acre and an API gravity of 28.5. A BTU rating ranging from 17,000 to 19,500 BTU/lb was found using a peroxide bomb calorimeter; percentage sulfur was determined turbidimetrically to be 0.034%. The research ended with separating and characterizing the oil's organic components. Results from the collected data appear favorable for establishing Euphorbia plants as an annually renewable source of petroleum.

#Second Award - General Motors ISEF

SYNTHESIS AND USES OF A NEW MIXTURE OF CYPERUS ROTUNDUS EXTRACT, CH_3COOH, HCL, AND WATER AS CLEANING, WAXING, AND SHINING AGENT FOR DIFFERENT SURFACES.

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The purpose of my investigation is to determine if an extract from the leaves of the plant Cyperus rotundus has cleaning, shining and waxing properties in polishing different surfaces.

Chemical analysis done in order to separate the chemical components of the extract, showed positive properties of this extract in cleaning several surfaces.

After having distributed this extract to a housewives in my community, an inquest showed that 92% of the housewives interviewed responded to positive uses of the extract as a cleaning agent.

This cleaning product has no ill effects on humans, has an aggreable smell and can be used safely in households.

Further studies in my investigation will include determination of exact chemical components found in the extract of the plant Cyperus rotundus responsible for these cleaning properties.

It also helps increase the visibility of drivers and passengers. I consider it will reduce the possibility of impacts due to the lack of vision on the window. It will help reduce traffic accident which I consider the majority of vehicles have their windows very dirty when accidents occur.

#Honorable Mention - American Chemical Society

CAN FRACTAL GEOMETRY REVOLUTIONIZE COMPUTER GRAPHICS TECHNIQUES BY LINKING EUCLID'S GEOMETRY & NATURE?

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Fractal Geometry is the mathematical study of forms having a fractional dimension. In the 1960's, Benoit B. Mandelbrot theorized that there is a continuous blending of dimensions. Just as there are an infinite number of fractions between consecutive integers, so there are an infinite number of fractional dimensions between dimensions. The question is: Can properties of Fractal Geometry that are similar to those in nature be used to improve techniques in creating computer graphics on an Apple II computer?

Mandelbrot used Iterative (Recursive) equations and complex numbers to create Fractals (Mandelbrot Set) graphically on the computer. The first task was to use Mandelbrot's method to create Fractals. In order to handle the huge calculations, the inverse of the equation was taken. In program #1, it was shown that Fractals possessed three properties of nature: Self-similarity, fractional dimensions, and continuity. By using program #1 and random numbers (To simulate the forces of nature), program #2 was created to graph mountain landscapes and bodies of water.

This new computer graphics technique has a wide range of applications. In Geology and Geophysics one can use program #2 to represent land formations, deposits, surveying, magnetic fields, and heat flow. Even in Medicine one can get exactness in graphical representations of the human anatomy. Military uses depend upon self-similarity, which opens the way to better guidance systems, flight simulators, and sonar, just to name a few. These applications, as well as computer graphics, of course, are very easy to adapt because all the representations are mathematical and logical.

TWO YEAR STUDY: INTEGRATED ROBOT ASSEMBLY

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2537 SW 13th Street, Boynton Bch, FL 33435

Through this investigation this researcher attempted to prove that if the X and Y axes of a robotic arm were separated so that a change in one would not constitute a change in the other the robot could perform more effectively.

The robot assembly in this year of experimentation was designed so that the X and Z axes are controlled by two wheels mounted on opposite sides of the base. These wheels can be controlled individually. When both wheels travel in the same direction the robot moves in the corresponding direction. If the directions of the wheels oppose each other the robot will rotate on its vertical axis. When one wheel turns while the other remains stationary the robot pivots about the stationary wheel. These wheels are sufficient to move the robot in any lateral direction.

The lateral direction does not affect the position of the Y-axis. Since all axes are independent that robot maintains a state of equilibrium; therefore, it is not necessary for the motors powering the axes to compensate for imbalances. Thus, the motors can be geared to move much faster.

Since the motors move faster the robot can perform more effectively and efficiently.

DETECTION AND CONTROL OF SOFTWARE PARASITES

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Software parasites, also refered to as worms, are small program that will attach themselves to application programs within a computer system. Each time the host program is run the parasite will reproduce itself on other programs running on the computer system. Because of their ability to infect an entire computer system in limited amounts of time, parasites pose a great security threat.

The procedure for this project included three steps:

I. A multiprocessing enviroment similar to the enviroment of most mainframe computers was created for the Macintosh microcomputer.

II. Three software parasites, each using a different method of attacking the computer system, were introduced into this enviroment. Each of the three software parasites introduced to the enviroment in this step was designed to use a different method of approach to attack the computer. The first parasite tried to attack the computer by changing the system software. The second parasite tried attacking the computer by allocating all system resources so that other programs would be stalled. The third parasite would bring about the demise of all programs it came in contact with after destroying all of their data.

III. A security program, designed to detect and then destroy software parasites, was written and installed in the enviroment created in step one.

After the computer had been infected and the parasite control software was in operation the preformance of each parasite and the parasite control software was measured. It was found that by using a confidence ratio, activity record, and violation record for each program within the computer system the parasite control software was able to find and destroy each parasite before it could corrupt any data.

#First Award - United States Navy/Office of Naval Research

SPRITE MOVEMENT AND THE SLOPE FORMULA

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This project solves a programming problem in BASIC with an application of mathematics. The math is the slope formula, which is used with the CALL SPRITE statement in Texas Instruments Extended BASIC.

The problem originated in the writing of a subroutine in a game; it was the calculation of an angle at which to drop a bomb on a radar station. The problem was then more generally defined as sending a sprite, or moving graphic, from one coordinate to another. Certain similarities led to the slope formula being a possible means of solution. Indeed it was and a preliminary program was written as a test. The formula was proven to be effective by this program, but it had some bugs which could only be corrected by the introduction of a constant speed for the calculated sprite movement.

The quest for a constant speed took quite a bit of room in the project, but perhaps it was the most important part. When this was solved, the project was complete ... almost. The finished formula was substituted back into the game subroutine. The constant speed resulted in a 100% accuracy rate.

These results prove the usefulness of mathematics within BASIC. Included within this project is an attempt at a solution which does not use any mathematic principles. The drastic change in accuracy from this effort to the final one using the slope formula (about 16% to 100%) speaks for itself.

DIGITAL SPEECH RECOGNITION AND VOCAL CONTROL

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1116 Greenleaf Court, Terre Haute, IN 47802.

During the next decade, man will be presented with many new and wonderful innovations in the field of computers, yet the most exciting of these is the advent of speech recognition. The ultimate step in closing the communications gap between man and machine, this system will allow a human operator to control a computer via spoken commands, thus doing away with the need for physical interaction. This will also allow those who are physically handicapped to control aspects of their lives once unaccessable due to their impediments.

Based on previous research in computer synthesis of speech and music, a basic, user-dependent voice recognition system was created to allow the use and programming of a TRS-80 Color Computer through verbal means. This system was then coupled to a servo-mechanical unit, thereby allowing an arm to be vocally controlled and "taught" by a user. This work, part of a four-year investigation into the expansion of a computer's sensory applications, will be added to in future research, and will include an optical sensor and recognition system, so that the computer can be "told" to "look for" an object in a sensory matrix, "decide" the location of the object, and send the arm unit to "retrieve" it.

Due to the complexity of the research, the project was divided into two phases: Phase I concerned the development of a vocal recognition system utilizing the SP-1000 IC from General Instruments Corp., and Phase II involved the adaptation of the low-priced Radio Shack ARMITRON for direct control by the Color Computer, as most finer servo-units are beyond the financial means of this project. When completed, both phases were linked by a recognition system entitled OVER-DOS.

#First Award - National Aeronautics and Space Administration

# COMPUTER MAZE-SOLVING

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The objectives of this project are to determine if a computer, specifically the TRS-80 Color Computer, can be programmed to solve complex mazes and to determine if the computer can be made more efficient in its maze solving abilities by "remembering" explored areas in the maze. Research was done in the area of artificial intelligence revealing information which aided in the development of the algorithms used in this experiment. A program to create and store mazes was developed. The program was then designed to store the maze in memory, to assign values to the walls and clear areas of the maze, and to proceed to solve the maze utilizing specific problem-solving logic. Another set of routines was implemented to the program to allow the computer to remember the areas explored in the mazes. To show the results, a printing routine was created which printed the maze itself as well as the computer's path through the maze. Thirty trials involving two complex mazes were completed, and these trials suggested that the first project objective, that is to create a program to solve complex mazes, was reached. Thirty-six additional trials were completed to show that the computer could increase its efficiency in solving mazes by remembering explored areas. Applications for this project include research into artificial intelligence and robotic navigation. More advanced algorithms are being developed to increase the computer's efficiency in solving the mazes.

#Third Award - General Motors ISEF

COMPUTER ASSISTED SUSPECT IDENTIFICATION 1.00 (C.A.S.I. 1.00)

Gerson, Michael, Ely H.S., Pompano Beach, Fla 33060;
1328 N.W. 100 Ave., Coral Springs, Fla 33065.

This project was done to show that a low cost, computerized system for simulating the faces of criminal suspects can be developed. Presently this is done only by specially trained police artists who can give their attention to the most heinous crimes because of their heavy work load. They simulate faces either by using an Identi-Kit, which consists of series of plastic foils or overlays, each having a different feature or by freehand.

The project consisted of digitizing selected Identi-Kit features with a Machintosh computer in conjunction with a Thunderscan digitizer, which converts images on paper to an electronic format understandable by the computer. Then two programs were written, one converting Thunderscan images to Microsoft Machintosh B.A.S.I.C. 2.0 (MBASIC 2.0) image files and the other to store the X and Y coordinates with the MBASIC 2.0 image file that determines the proper placement of the image. Another program was also written that enabled the computer to manipulate the MBASIC 2.0 image files created above.

Computer Asisted Suspect Identification 1.00 (C.A.S.I. 1.00) is a feasible, low cost alternative to police artists, designed to allow any layman to use the system. This will provide the necessary attention to the lesser crimes that police artists have been unable to give their attention to. The C.A.S.I. 1.00 system will decrease the time it takes to apprehend suspects, thereby lowering the rate of lesser crimes and improving society in general.

#Fourth Award - General Motors ISEF

# A GEOMETRIC THEOREM-PROVING COMPUTER PROGRAM

Kellogg, Christopher J., Patrick Henry H.S., Glade Spring, VA 24340;
Box 24, Emory, VA 24327

The intent of this project was to write a program capable of proving geometric theorems. I did this, without any assistance, using Commodore BASIC; the program could easily be translated for other computers.

The program first inputs the given statements and the statements to be proved. The given statements can be entered in any order without confusing the computer. The statements are all translated into a special code that I developed to save runtime and memory. Different parts of the program try to generate new statements from these encoded statements, until the theorem is proved. Usually, few unnecessary statements are generated.

Once the theorem has been proved, it must be displayed so that one can see the results. One part of the program decides which of the generated statements are necessary for the proof. Another portion translates all the necessary statements into English. The statements are then printed out in two-column form, with word-wrap.

The program can prove a wide variety of theorems — about as many as a first-semester geometry student could prove. The built-in sections deal mostly with angles, but they can work just as easily with other measurable figures, such as segments. All theorems that could be proved by a human with the knowledge of the same theorems that the program uses can be proved by the computer. Most theorems take about half a minute to prove. The program is complete in itself; however, it can easily be expanded to include different kinds of theorems.

#Honorable Mention - Upsilon Pi Epsilon, the National Computer Honor Society

* COMPUTERIZED SPEECH ANALYSIS AND RECOGNITION

Donath, Carl T., LaFayette High School, LaFayette, NY 13084;
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One need in the computer field is for a computer that can listen to and understand spoken words so that people may use one without typing. This project is my solution to this problem. First, I had to design and build an electronic circuit that could convert sounds into a series of numbers. The sounds (which are really rapidly changing air pressures) are turned into electrical voltages by a microphone and a pair of amplifiers. An analog-to-digital converter then turns the voltages into numbers for the computer to analyze. Once the circuit was working, I wrote a computer program that would listen to a word, store the numbers describing it, and allow me to analyze it several ways as I searched for some feature that would discriminate one word from another. The method of drawing an envelope around the graph of a word to show the general changes in amplitude (or shape) of a word proved to have the most potential. To recognize a spoken word, the computer stores several envelopes in memory and the graph of the word to be recognized is compared with each envelope to see which shape it best fits into. The envelope that best fits the data is assumed to be the same word, and the computer then performs whatever action the word commands.

*First Award - National Aeronautics and Space Administration
Fourth Award- General Motors ISEF

# PARALLEL PROCESSING WITH MY PERSONAL COMPUTER

Shirazi, Nabeel, Beavercreek H.S., Beavercreek, OH 45385;
2416 Apricot Dr., Dayton, OH 45431

The objective of my investigation is constructing, implementing and testing of parallel processing in an Apple II+ personal computer for the purpose of improving its computational performance. To this end, I acquired the necessary electronic components and constructed two Z-80 based microprocessor cards, called APPLI-CARDS. I inserted these cards in proper locations in the Apple computer. For testing the computational performance of my computer with these additional processors, I have written programs for sequential and parallel processing, for obtaining the solutions of three problems which may be stated, in general, as follows: 1. Addition of the first n integers; 2. Evaluation of polynomials of degree n; 3. Solution of a system of n simultaneous equations. The computation time required using parallel processing is compared with the time required using sequential processing for different values of n. For small values of n, i.e., small computational loads, the solution time required using parallel processing is larger than the time required using sequential processing. This is attributed to the "computation overhead" of parallel processing. However, for large values of n, i.e., large computational loads, the solution time required using parallel processing is less than that of sequential processing. For further research, I have obtained a system of parameters, related to the computational problem of adding the first n integers, for trade-off studies in the design of a computer having parallel processing architecture. The variation in the values of these parameters with respect to the number of parallel processors has been obtained.

*Third Award - IEEE Computer Society
Fourth Award - General Motors ISEF

LIVESTOCK TRACKER

Nab, Leon E., Lingle H.S., Lingle, WY 82223
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The problem was to build a computer program on the TRS-80, Model III computer that will keep track of Cattle, Hogs, and Sheep. In order to do this, I will have to save data on a disk. The data will include everything that I need to know about the Livestock. For example, I will need to know theireartag number, breed, sex, and ect., ect. The first thing I had to do was to learn how Random Access Files work. I read our computer manuals at home, and the parts about the files I didn't understand, my programing teacher at school helped me. I thought they were hard at first, but the more I worked with them, the easier they got. Next, I gathered all the information I would want to know about the cattle, hogs, and sheep. After I got all the information, I was ready to start my program. The way I want to set the program up is to have the user input the information about the livestock. In order to do this, I will ask the user a series of questions about the livestock. Then, when he needs the information about the livestock, he can get it off of a disk, then he can print it out on the screen or make a hardcopy of it. It took me about four months to build the program. I learned a lot of new commands. When I finally got the program all done, I ran through it serveral times to get all the "bugs" out of it. When I thought I had all the "bugs" out of it, I let my dad and programing teacher at school run through it. They couldn't find any "bugs" either, and they were really pleased with the way it worked. I was really pleased too, because it turned out just the way I wanted it to work.

COMPUTER SIMULATION OF THE RANDOM MOVEMENTS OF A PARTICLE

Tromey, Thomas J., Buena H.S., Sierra Vista, AZ 85635;
1781 Driftwood Circle, Sierra Vista, AZ 85635

PURPOSE

The random movements of a particle are omnipresent in our everyday world. For instance, the path traced by cigar smoke as it trails upward, or the path followed by an electron in an electric field, are both examples of such motion. With the insertion of the possibility of the particle reacting with something already there, this simple procedure can be used to simulate the reaction in a chemical beaker, or the path of an electron through a semiconductor.

PROCEDURE

This project was done entirely by computer. The particles were moved around an array within the computer's memory. The computer then stored such information as the mean squared displacement of the particle from the origin, the number of particles left at that particular time, and the number of new nodes visited at that time.

RESULTS

The particle was discovered to follow a basic equation depending upon several variables: whether or not reacting nodes were used, whether the lattice was one- or two-dimensional, and the method used to choose the particle's direction of movement.

CONCLUSIONS

This experiment was a success. The random movements of a particle were effectively simulated.

#TOWARD A MORE EFFICIENT MODEL OF CLOUD FORMATION

McIrvin, Matthew J., Thomas Jefferson H.S. for Science and Tech., Alexandria, VA 22312; 13525 Ellendale Dr., Chantilly, VA 22021.

Purpose: To improve on existing computer models of cloud formation by employing a varying-resolution technique.

Procedure: This program simulates cloud formation in three dimensions in a 10-km cube of the troposphere. It treats a cloud as a collection of convecting bubbles which follow laws of gaseous dynamics as they rise and produce condensation. The program starts out dealing with large volumes of air over large intervals of time and gradually increases in resolution, a technique initially used in computer graphics to produce fractal landscapes. This allows detailed simulations to take place quickly on a personal computer. An additional program displays three-dimensional cloud data in an isometric projection.

Results: The program produces results strongly resembling cumulus and cumulonimbus clouds; the clouds vary with temperature profile and humidity as actual clouds do. A typical run takes 30 minutes to an hour of real time and covers 45 to 75 minutes of simulated time.

Conclusion: The use of varying-resolution simulation can yield fast and detailed cloud-formation modeling on a small computer.

#First Award - American Meteorological Society
London International Youth Science Fortnight - United States Navy/NORDA
Second Award - General Motors ISEF
Second Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society
Alternate to Scholarship - United States Navy/NORDA

SCIENCE INVENTORY

Boorman, Brian C., Avoca Central, Avoca, New York, 14809
16 Maple Ave., Avoca, New York, 14809

My exhibit is a computer program designed to make a working inventory of chemicals and labware in a science room or storeroom. It is composed of six major routines. Three are for chemicals and three are for labware. The program can save, retrieve, edit, or delete data. It can also make a printed copy of the data through any one of seven searches for the labware and through any one of eight searches for the chemicals. The program was written in Apple II BASIC. PRODOS was used as the disk operating system. It works on an Apple IIe or IIc of at least 64K memory. Two disk drives will make this program work faster, but the program will also work on one disk drive. Also needed is either a serial or a parallel printer with an interface hooked on-line to the computer in order to use the 'printed copy' function. A blank data disk is needed and the program will initialize it for you. It is suggested that the user have one data disk for labware and one for chemicals, however you can use one disk for both.

# CONCEPTUAL LANGUAGE TRANSLATION

Minakami, Michael, Moanalua High School, Honolulu, HI 96818
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CELT is a project in machine translation designed to allow translation between any two languages. It consists of three programs developed from 1982 to 1986: LTS-1, a literal translation system, Savant, a concept identification program, and Polyscript, a transliteration program.

Translation is divided into two parts: an analyzation of ideas in the sentence and a literal translation. The analyzation, using artificial intelligence algorithms, prepares the sentence for a literal translation by replacing figurative terms with exact literal meanings (ex. "green" replaced with "inexperienced" or "unripe," depending on context). Once analyzed, the sentence is translated literally by applying grammatical equations to determine sentence parts such as the subject (ex. IF NOUN+VERB THEN NOUN=SUBJECT). The sentence may then be transliterated to its native alphabet.

CELT may be applied in areas involving communication between countries, particularly in international networks. It could intercept an incoming message, translate it to a specified language, then display it in the appropriate alphabet. For practical use, the knowledge base should be expanded to include thousands of entries and run on a computer having a minimum of several megabytes of memory. Through careful indexing of this data and parallel processing, a five second translation time should be possible. Future improvements to CELT may include vision, speech, and hearing systems.

#Third Award - General Motors ISEF

COMPUTER SYSTEM FOR THE HANDICAPPED

Smith, D. Scott, Farragut Community School, Farragut, IA 51639
RR 2, Farragut, IA 51639

The purpose of this project was to determine if a computer could be adapted for a motionally handicapped or blind person. Through eight months of work I have researched and developed such a system.

The Alternate Input and Output system uses a joystick or touchpad in place of the keyboard for those who cannot type. For the blind, I have replaced the monitor with a speech synthesizer. The software system gives the alternate input user all the power the keyboard user has. All edit features are supported by the English Based Interactive Language(EBIL), Word and Talker.

EBIL is a super high level language that is easy to use and learn. Word is a simple word processor for the alternate input system. A speed of twelve words per minute is possible using the alternate input (a joystick or touchpad). Talker is a simple program that allows the vocally disabled to speak through the speech synthesizer. All these programs can use the speech synthesizer for output, so the monitor is unnecessary.

Through self testing without the monitor and keyboard, I have found it possible to write a working computer program, write a letter or communicate to others using devices other than the keyboard and monitor. This system could be applied to most computers and could be customized for different situations. Where once impossible, the Alternate Input and Output system now makes it possible for a blind or motionally handicapped person to use a computer.

#A NEW ALGORITHM FOR OPTIMAL ROUTE SELECTION

Heady, Pamela S., NW Rankin H.S., Brandon, MS 39042
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In the future, robots will become more mobile. However, to be really useful they must be able to execute optimizing commands. The Traveling Salesman problem involves such an optimizing command. It requires finding the shortest simple path connecting a given set of destinations. An N-station Traveling Salesman problem has (N-1)! possible paths, and for N greater than about 20 even the fastest computer can not do an exhaustive search in a reasonable time. By using the most advanced search algorithms, problems with about 30 destinations can be solved, but still only when run for weeks on a Cray computer.

My goal was to find a very fast, very accurate approximate solution to the Traveling Salesman problem. I hypothesized that useful results could be obtained by eliminating the requirement of reaching the exact solution. This is a practical goal because in many situations a path that is only slightly longer than the best will be considered adequate.

By using geometric analysis I found four principles which allow 30 point problems to be solved in about 7 seconds. The 48 state Traveling Salesman problem was solved in about 14 seconds. For N less that 150, my program runs in polynominal time (exponent=1). Where I could check the solution, it was always exact, but I can show that certain cases will not be precisely correct.

I call this a "robotics solution" because it is much more accurate and far faster than what a human can do, and can be programmed into a small, mobile computer.

#First Award - Association for Computing Machinery
First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - United States Army
Scholarship - United States Navy/Office of Naval Research
Second Award - IEEE Computer Society
Second Award - United States Air Force
Third Award - Society of Manufacturing Engineers
Glenn T. Seaborg Nobel Prize Visit Award

#IMAGE PROCESSING III: CHARACTER RECOGNITION

Hillyer, William B., Pickens Academy, Carrollton, AL 35447
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In the past three years, when working with various types of imaging systems, I came upon many problems, such as friction, rotational scanning, and varying light conditions. The purpose of this project is to design a system that overcomes these problems and explains the main principles of an image processor.

In this project, the image processor consists of two major parts: acquisition and computing. During acquisition, the camera, mounted on a printer, scans across the page of characters and stores the information for analysis. During computing, the imaging system analyzes the data through binary thresholding, boundary testing, convolutioning, and template matching. Afterwards, the computer makes its final decision and displays it on the screen.

Along with designing the imaging system, I also experimented with different colors, styles, and sizes of letters to find out which ones work best with my system. I also experimented with different light intensities by varying the voltage to the light bulb in an effort to fine tune the system. Although my processor is a primitive system, it works quite well and shows the basic principles behind image processing.

#Third Award - Marine Technology Society/U.S. Naval Institute

*ANALOGIES AND THE COMPUTER

Coen, Michael H., Stuyvesant H.S.,
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360 East 72 St. N.Y. N.Y. 10021.

Today computers are used almost exclusively for repetitious calculations. Most people recognize the time saving capabilities of the computer; few realize its full potential. If interaction with automata was simplified, anyone would be able to use a computer and with a great deal of efficiency. Therefore, a need exists for computers to understand human given instructions.

For this to be so, computers must be taught the meaning of language. Then they need to understand the ideas that the words are conveying. This involves a combination of computer science, linguistics, and mathematics.

Taking the idea that humans follow programs as do computers, one can support that artificial intelligence will reach enormous levels. A program need only be sufficiently complex to mimic the thought, make similar decisions, and reach the same conclusions as a person would.

My major aim was to determine whether a computer could simulate human thought. Also, I wanted to teach it the fundamental basis of language. I developed a word classification system which a computer could use to understand the definition of a word. I used analogy problems from the College Board S.A.T. exams to test the system, because they are the simplest form of a definite relationship between words.

*Second Award - American Psychological Association
Honorable Mention - Association for Computing Machinery

COMPUTER CONTROL

Marshall Robert
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46 Wilton Court
Washington, WV 26181

PURPOSE: This project controls 16 binary outputs with a computer using addressing techniques. With the use of methods demonstrated in the circuit a large number of outputs can be controlled by a proportionately few number of pins.

HYPOTHESIS: A computer can be used to control external devices by use of addressing techniques.

DESCRIPTION: The circuit uses two address pins, 4 data pins, and an enable pin from the computer. The address pins control the 7445 addressing chip. It's function is to convert a binary input to an analog strobe used in addressing. The data pins are connected to the 74100 latch chips. They are used to take in data sent by the computer when signalled by the address chip, and to independently maintain this output. The enable pin is connected to the addressing chip. It is used to disable the output of the computer in order to allow changes to be made in computer output without affecting the output of the circuit board. The computer sends the binary address to the addressing chip. The addressing chip sends an enabling strobe through an inverter to the enable pin of the corresponding latch chip. When a latch chip is enabled, it reads the data lines and maintains this output until againg signalled by the address chip. The enable pin makes the address chip access nonexistant locations to satisfy its function. The latch chips output to the actual devices (such as those in the display).

#DIGITAL IMAGE PROCESSING ON AN APPLE//e MICROCOMPUTER

Wilkinson, Stephen, Duncan H.S., Duncan, OK 73533
4445 Odom Dr., Duncan, OK 73533

This project was originally intended to be a study to determine if mainframe image processing programs could be translated to an Apple IIe micro computer. However, after a lengthy literature search, no programs or desctiptions of these programs could be found, so original programs were designed and written in Pascal.

A novel way of digitizing was developed using a Radio Shack four pen plotter and a TRW Reflective Object sensor(OP7390). A program was written to drive the plotter and read the voltages from this sensor. The signals from this sensor were fed into the Apple's on-board analog to digital converter.

The unprocessed data from the sensor was stored on diskette in a specially developed, space efficient, format. This data uas made available to the other program modules.

Several data processing programs were developed to display this data. Contrast stretching, edge enhancement, and noise filtering algorithims were designed and coded, in addition to an isophote and histogram display. Lastly, a three dimensional surface plotting routine with hidden line removal was designed.

All of the above programs were openly designed so that future developments or algorithims could be easily incorporated.

Applications include such diverse fields as medical technology, military intelligence, robotic image recognition, astronomy, and the space program.

#Alternate - Society of Exploration Geophysicists
Third Award - General Motors ISEF
Honorable Mention - Upsilon Pi Epsilon, the National Computer Science Honor Society

# ROBOTICS AND ARTIFICIAL INTELLIGENCE

Attlesey, Chad D., John Marshall H.S., Rochester, Mn 55901
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This project attempted to demonstrate an artificial intelligence that had the ability to assimilate knowledge of its surroundings and use it to operate more efficiently.

I designed and constructed a small robot that was able to maneuver in a maze-like room in which the configuration of the obstacles within could be changed.

Next, I wrote a program (MAZERUN III) for my computer which controlled the robot's movement, memory, learning and decision-making. Starting in one corner of the room, the program instructed the robot to make its way to the opposite corner. When it encountered an obstacle, the robot backed away, placed the location of the obstacle in its memory, and attempted to proceed in another direction. After one successful run, the robot was returned to its original position and navigated the area again. In this run, however, the robot knew where the obstacles were located because it had "learned" their positions during the previous run. Using this knowledge, the robot chose and traveled the most efficient route. After the second journey, the program then displays all of the data gathered and gives the user the option of saving it. Later, this data can be retrieved, viewed, and/or printed on paper.

I believe this project was successful in demonstrating machine intelligence. But, more gratifying to me was that my program created some second-run routes that required almost 90% less maneuvering than the first. A maneuvering efficiency of 90% was outstanding.

#Fourth Award - General Motors ISEF

ChemCalc

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Route 3, Box 78-Q, Berkeley Springs, WV 25411

The goal of this project was to develop a computer program that would balance chemical equations and compute stoichiometric problems (mass-mass, mass-volume, and volume-volume). The resulting program is named ChemCalc and performs all of the above functions automatically.

The first step in solving stoichiometric problems is to balance the equation. First, the formula names are parsed and the atomic masses computed. The equation is converted to a matrix form and this matrix is reduced using a variant of Gaussian elimination. The coefficients are then extracted giving a balanced equation.

The next step is to compute the number of moles, the mass and the volume for each substance in the equation using a single known value input by the user. If the input value is in mass or volume units, it is converted to moles. The mole values for all substances in the equation are calculated using the coefficients as ratios. Finally, the mole value for each substance is converted to mass units and volume units, completing the calculations.

The initial version of ChemCalc was written in Applesoft BASIC for the Apple IIe personal computer. Several seconds are needed to balance an equation and calculate the atomic mass of the substances in the reaction in the BASIC version. The current version (1.2) is written in PASCAL for the IBM Personal Computer. Many improvements were added including selectable units of measure and a windowing system.

#Third Award - General Motors ISEF

# TEXTLINK: THE PRINTED WORD TO COMPUTER VIA STRUCTURAL CHARACTER RECOGNITION

Calabrese, David, Morse H.S., San Diego, CA 92114;
7807 Hillandale, San Diego, CA 92120

Much of the true power of computers lie in their ability to process information. Getting this information into the computer, however, can be amazingly difficult. This problem became particularly acute after the word processor took over the job of the typewriter. People were left with large amounts of old typewritten documents that had to be entered into the computer. Their only solution was to tediously re-type them. A much more efficient method would be to have the computer itself read the text off the paper directly. Doing this at a low cost has been just about impossible. Until now.

With the use of my TextLink system, nearly anyone can take pages of typed or printed text and have the computer read it automatically. Things such as reports, letters, memos and even entire books can be entered into the computer. Once in memory, they can be put in a word processor for editing, used as part of a data-base, etc.

TextLink uses software-based structural character recognition to isolate and identify characters within a computerized "photograph" of a printed page. The theory of recognition is based on the unique structural components that make up individual characters. Being software implemented, the only cost of the system is the digitizer which takes the "photograph." In using software recognition with low cost digitizing equipment, TextLink makes reliable text reading from the printed word available to practically all computer users.

#First Award - Upsilon Pi Epsilon, the National Computer Science Honor Society
Second Award - General Motors ISEF
Honorable Mention - American Intellectual Property Law Association

DEVELOPMENT OF A COMPILER FOR THE CONVENIENT IMPLEMENTATION OF PASCAL

Kollmorgen, Paul L., Lutheran High North, Mt. Clemens, MI 48044
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I developed a tiny-Pascal compiler that operates with the ORCA/M operating system. This is important and worthwhile because at this point in time there is only one compiler for this system and it is limited (Small C) and slow. ORCA/M allows programmers to program in many different languages, using each language's strengths, and incorporating all the code generated by the compilers into a single program. I have been using ORCA/M and have observed that an efficient, speedy compiler would help facilitate programming. I contacted the originator of the ORCA/M system, and maker of the only associated compiler. He was most encouraging and eager for me to develop compilers for other languages. I chose to work with Pascal because of its functional popularity. I chose to make a "tiny" compiler because it creates fast and compact code. The compiler can't compile every statement of Pascal, but it can compile many of them. A compiler is one of the most sophisticated programs for any computer, and therefore a very involved and complex task.

*COMPUTER SPEECH

YU, Kevin C., Woodham High School, Pensacola, FL 32504
6541 Scenic Highway, Pensacola, FL 32504

A computer can communicate with humans through a voice synthesizer. A voice synthesizer converts the computer's signals into audio signals which are amplified and transmitted through a speaker. The speech synthesizer used in this project was constructed using an SP0256-AL2 allophone speech chip. This chip produces sounds instead of entire words, allowing the computer to have an extensive vocabulary. The computer software directs which group of allophones to send and in what order to send them.

The software operates on a 640K IBM PC-XT which has one parallel port, one serial port, color monitor, and two disk drives. The software is a menu-driven package allowing user compatibility. The entire package utilizes menus and the built-in function keys of the IBM. Furthermore, the user can create, add, and edit one's own vocabulary.

*Fourth Award - General Motors ISEF
Honorable Mention - Acoustical Society of America
Honorable Mention - National Aeronautics and Space Administration

A PRINTER PORT CONTROLLED ROBOT

Aschermann, Scott M., Rocky Ford H.S., Rocky Ford, CO 81067;
1317 Pine Avenue, Rocky Ford, CO 81067.

No exhibit.

A.R.M. AND THE DAY-NIGHT SHIFT THEORY

Deem, Steve V., Weber H.S., North Ogden, UT 84404;
1191 East 3150 North., North Ogden, UT 84404.

The A.R.M. is short for Automated Robotic Mechanism. This project uses the most advanced robotic arm per costs and combines the huge capabilities of the computer software to replace hardware. This A.R.M. uses all RAM instead of ROM. This allows the computer to change the program in memory quickly and makes the robot allowed to take on other responsibilities.

The DAY-NIGHT shift is what I call the ability the robot has aquired to take on this additional responsibility. I therefore shift all of the work to the software and thus making the use of hardware very limited. This allows the same robotic set-up to perform several different tasks at the touch of a keyboard. This DAY-NIGHT shift will allow the RAM to instruct instead of the ROM,PROM or Eprom to tell the robot what function to perform all the time and never to change the robotic function. The new DAY-NIGHT shift will allow more unique software design and more specific robots to perform very specific tasks. This robot will also have the ability to change it's function at any time and to do any different task, any length of time.

This robot will make the entire industrial and commercial world take a look at robotics and to use them in more and more tasks and for more and more different time sequences.

PAL-8000, THE ODYSSEY CONTINUES

Keith, Scott, Greenwich High School, Greenwich, CT 06830
181 Cognewaugh Road, Cos Cob, CT 06807

The purpose of this project is to design a new type of artificial intelligence system which uses human reasoning and learning techniques.

As people expand their knowledge, they create new connections among data and modify their internal "program" with the result that new problems can be dealt with in a more effective way. In the same way, a computer can be made to remember new information, create new connections, and alter program code in order to produce a change in behavior.

To implement this idea I designed a new artificial intelligence language that will allow programmers to develop concurrently running modules that can be self-adaptive to accommodate new situations and data. The language interpreter uses a global data tree for storing and manipulating both program code and logical data. The result is a new set of tools for artificial intelligence development.

The PAL-8000 is the result of two years of study in artificial intelligence. The total system is still under development; however, a core element, the relational data tree, has been completed and will be demonstrated. This tree is a modified parse tree that has definable indicators which tell the computer what type of information is stored in each branch and how it relates to its root and other trees. The entire system will be able to access the code which is stored in the parse tree, altering it to solve new types of problems .

In the future, computers that are self-adaptive will have tremendous application because they will not require detailed programming for each particular application; they will adapt to the particular needs of an application by run-time reprogramming.

#A TWO YEAR STUDY INVOLVING RESEARCH AND DEVELOPMENT OF A COMPUTER MUSIC PRODUCTION SYSTEM

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The very same technological breakthroughs that introduced us to the microcomputer have dramatically changed the way music is made today. Advanced electronic devices have now made it possible to synthesize new musical sounds.

This project has become a quest for ultimate computer music system using the latest technologies in microelectronics and computer coftware. During the 24 month research period, 8 conputer controllable hardware synthesizers were designed and constructed ranging from the simplest of analog designs to very complex digital systems. However, they did not completely satisfy the needs for an ultimate computer music system. Research revealed that all of the exceptional electronic synthesis components were under lock and key by their parent companies. Unable to acquire these components the solution was to use commercially available synthesizer systems in conjunction with a personal computer. Connecting the two devices became a complex task but was solved by developing hardware that was capable of implementing the industry standard music/computer interface-MIDI.(musical instrument digital interface). Six months, 1500 hours went into writing COLORCHESTRA, the final software package. COLORCHESTRA, a total electronic music recording and production system developed in 100% machine language is over 32K long and incorporates its own DOS. Although designed for the music industry, COLORCHESTRA's features make electronic music now available for education, psychiatric therapy and a myriad of other applications.

#First Award - General Motors ISEF

TEXT-TO-SPEECH SYNTHESIS

Knight, David J., Bradford Area High, Bradford, PA 16701;
10 McKune Ave., Bradford, PA 16701.

Action is a basic and universal form of communicating. Sound communicates action through the air. Sight communicates action through light patterns. Touch communicates through action of contact, pain, pressure, and temperature. Smell and taste communicate with actions of chemicals. These basic senses can be broken down into a universal action. After converting the senses to action the message to be conveyed can be redirected to a different way of communicating, much like writing to the eye, could be changed to braille for touch.

The purpose of this project is to use a computer and speech synthesiser as a universal medium into which all stimuli of action can be broken down, processed and changed. This will meet the needs of people who have a dependency on sound both in hearing or speaking.

PANOPTICONS

Lane, Kenneth M., Wando H.S., Mt. Pleasant SC 29464
6815 Limehouse Rd., Awendaw SC 29429

A panopticon is an image that is distorted in such a way that, when the image's reflection is viewed in a cylindrical mirror's outer surface, it is changed back to the image originally intended. My purpose in studying panopticons was to discover what distortions take place when viewing a panopticon, and ultimately to discover a way to simulate the distortions so that it would not be necessary to distort the image by hand. My procedure was essentially to sit with a pencil and paper, and figure the distortions out. After that, the computer was brought into the picture. I have now developed several programs that simulate the distortion. The conclusion and result is that a set of equations may be used to simulate these distortions. A very good question at this point may be, "What on earth is it good for?" The answer is that it can be used as a kind of 360° vision device. Two video or still photo cameras could point in opposite directions and be focused on cylindrical mirrors (or lenses that simulate the same distortion). The resulting images can be processed with the panopticon formulas. Thus, any part of the field of vision could be made "normal." This could be used to free the field of view of cameras on remote devices, or to improve simulators, or even to correct for the curvature of the earth in satallite photography.

THE THIRD PLANE

Gorelick, Noel S., Northeast H.S. OKC, OK 73111
710 NW 31, Oklahoma City, OK 73118

This project is a computer program designed to graph three-dimensional equations of the form $z=F(x,y)$, and applications of the sub-routines that were developed with it.

The final result of the project produced a very short 15 line program that will graph in three dimensions, almost any equation in graphic detail. The program also allows the possibility of enlarging a section of the graph and presenting the graph from a different perspective angle. With several small additional sub-routines, it can find the surface area, graph between two functions, and produce hidden line perspectives.

The program also has the capability, through another sub-routine, to smooth graph a set of entered data points by converting them to a usable parametric equation.

An obvious practical application of the program is topographical mapping from any set of entered data points (sonar, radar, spectrograph readings, etc.)

Another practical application is a by-product of one of the sub-routines. It is a computerized wind tunnel that allows the user to actually draw an object and find the drag on it.

Although computer graphing programs are rather commonplace, what makes this program unique is it's length an running time. (currently runs in 45 seconds)

#COMPUTER INTERFACES FOR THE HANDICAPPED

Langdon, Bryan, Saint Pius X High School, Albuquerque, NM 87110
11513 Bar Harbor NE, Albuquerque, NM 87111

The purpose of this project is to develop a method by which handicapped people can communicate with the computer. Many handicapped people have the ability to understand how the computer works. The major obstacle that prevents handicapped from using computers is that they do not have an effective way of utilizing the keyboard. The idea behind this project is to design, build, program, and examine various ways of talking to the computer and how they relate to the handicapped.

The handicapped people that I chose to design this project for are those that are physically handicapped. The first step of the project was to do research using available resources in order to find out what limitations various handicapped people have. The second step was to analyze exactly what type of interface would be suitable for these physically handicapped people. The third step was to look at available interface devices and see if any of them apply. If none of the interfaces were applicable then an interface had to be devised which could be used. The fourth step of the project was field testing or actually giving some handicapped students the opportunity to try out the interface devices with the programs. The final step of the project was refinement of the interfaces and programs.

#First Award - United States Air Force
Honorable Mention - American Speech-Language-Hearing Association

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VIDEO DIGITIZING AND IMAGE PROCESSING OF TWO AND THREE DIMENSIONAL OBJECTS TO ASSIST ROBOTIC APPLICATION IN HOME ENVIRONMENTS

Holmes, Michael Vaughan, A.P. Brewer H.S., Rt 2 Box 149
612 Heather Street, Lacey's Spring, AL 35754

Robots have been very successful in their role in industry where they repeatedly perform precise operations. Industrial robots are very costly but very cost effective. The home robot is and will remain a toy or conversation piece until research, like this project, develops practical and cost effective solutions and approaches for home application. In this project the robot has the ability to see and make decisions with the help of a video camera, digitizer, and appropriate computer programs. With these capabilities a robot may soon be a useful tool in the home instead of just a toy. This project develops, tests, and evaluates theoretical techniques in home application of robots.

This project demonstrates:

- Specular enhancements assist in three dimensional image processing.
- Bulk filtering eliminates background images and clutter.
- Benchmark objects reduce the task of object classification.
- Multiple angle viewing assists object identification.
- A combination of theorectical approaches is required to assist robots in home environments.

CAN THE FORTH PROGRAMMING LANGUAGE BE USED TO CONTROL A ROBOT ARM?

Walzak, Terry B., Cocoa Beach High, Cocoa Beach, FL 32931
2001 S. Banana River Blvd. Cocoa Beach, FL 32931

The FORTH programming language is unique in that it has the potential to create new commands based on feedback from previous commands. One limitation of previous research was that the robots built aided in home management, but only by performing unalterable tasks. In using the FORTH computer code, the researcher attempted to construct routines which simulate artificial intelligence by using self-defined arm movement commands. When applied to a robotic arm, elementary routines were developed to allow the arm to be free of constant human control. Ultimately, the researcher will then program a robot to grasp selected objects and perform simple household chores. The FORTH language will allow the robot to adjust to new conditions and stimuli as the need arises.

COMPUTER BIO-TELEMETRY

Hope, Leonard J., Ridgewood High School, New Port Richey,Fl33552
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For many years scientists have tagged and tracked animals with the hope of learning something of their habits. Until recently, this was the only method. But, with the advent of miniature radio transmitters this can all change. Now, scientists can tag the animal with a transmitter and follow the signal on foot or in a vehicle. But, this too will change with the system that has been created during the course of this investigation. Now, with this system, it will only be necessary for the scientist to tag the animals and let them go. The computer can then monitor and record the position and whatever other data the transmitter is capable of sending. This frees the scientist from gathering the data and allows him to do the ever important job of interpreting it.

VOICE RECOGNITION FOR COMPUTER SOFTWARE DEVELOPMENT

Tucker, Mark, Davis H.S., Kaysville, Ut 84037
141 W. 400 S., Kaysville, Ut 84037

This computer system was developed to enable a person to write a program by using verbal commands. With this system a program can be constructed, modified, and saved with minimal typing. The system can also be used by the handicapped and those who can't type or use a computer keyboard.

The entire system consists of a hardware interface and two main software programs. The interface consists of an audio amplifier, counter, clock, and an Analog-to-Digital Converter. This interface accepts voice patterns and converts them into binary form for computer processing. The first program accepts voice inputs and creates a file of the voice patterns. This file will then be used by the second program which accepts voice inputs and compares them to the ones that were saved. When a positive comparison has been made it will write the corresponding command to a "program" file. This file can then be loaded and run as a normal program.

#ENGLISH TO RUSSIAN TRANSLATOR

Schoenly, Steven B., Oxford High School, Oxford, MS 38655
3012 Hillmont Drive, Oxford, MS 38655

This program was written in Microsoft Basic on a TRS-80 Color Computer. The program prompts the user for a simple English sentence. The sentence may consist of any of the pre-programmed vocabulary words, in any grammatical order. The vocabulary may be viewed by typing 'help' at the prompt. The Russian alphabet may also be viewed by typing 'alphabet'. If the user, however, inputs an English sentence, the process of translation begins. Using parallel English-Russian vocabularies, each English word is translated into a set of Roman characters. These characters are then changed, one by one, into Cyrillic characters. These characters are drawn on the display screen in the high-resolution graphics mode. As the characters are being drawn, a speech string is assembled. This string uses a one letter-one sound system. Letters which in sequence form Russian dipthongs are then converted into the correct phonetic symbol. The speech string is output through a Tandy Speech-Sound Synthesizer. The program returns to the prompt after any key is pressed.

#Honorable Mention - Association for Computing Machinery

EARTH AND SPACE SCIENCES

THE RARE AND FAMOUS SIGHT "HALLEY'S COMET"

Miles, Kimberly Rhae, Graceville H.S., Graceville, FL 32440
PO Box 347, Graceville, FL 32440

The purpose of this project is to determine when and where to view Halley's Comet.

Procedures include extensively researching available books, periodicals, and pamphlets.

I plotted the coordinates of Comet Halley on the first day of November 1985 thru April 1986 and compared them to the coordinates of the first day of November 1910 thru April 1911. Through the use of an Apple II-E computer, I was able to plot coordinates giving more exact positioning on the requested dates. Coordinates for the "Comet" were specified by elevation, azimuth, hour angle, the sun angle in relation to the comet date.

Research and generated data reveals that Halley's Comet appears only every 76 years. The comet will be visible from October to May. The comet may best be seen in the southern sky during the first week of April. It is best seen after moonlight diminishes. A good view of the southern horizon is a must, free from trees and tall buildings. It will take a devoted comet watcher willing to rise before dawn. Later in April the northern latitudes will have one more chance after dusk. In May, Halley departs into deeper space not to be seen again until around 2061.

#THE EFFECT OF MATRIX POROSITY ON THE DEVELOPMENT OF CRYSTALS IN GEODES

Galitzer, Tammy L., Pikesville High School, Pikesville, MD. 21208;
2324 Micarol Road - Baltimore, MD. 21209

For many years, I have collected rocks and minerals. I observed many interesting things, such as the fact that most geodes form in sedimentary rocks. According to my previous experiments, evaporation and force affect crystal development. If the crystals in geodes are surrounded by a sedimentary matrix, then how can crystals develop without being exposed to air? My research into geode development helped me to finalize my problem.

I set up my experiment to grow crystals in geodes. After calculating the porosity of natural and simulated sedimentary rocks, I tested three types of porosities: Most porous, average porous, and least porous under three different test conditions: 1. one time exposure; 2.constant exposure; and 3.air dried. Small geodes were made in order to keep constant track of crystal growth and larger geodes were made to observe the final result. Cooled supersaturated solutions of Potasuim Dichromate, Magnesuim Sulfate, and Copper Sulfate were used. I set up a schedule to saw open the geodes and readjusted this schedule according to my observation. Observations were made with a hand lens and microscope scrapings from the top, middle, and bottom of the simulated geodes.

Data revealed that the lower the porosity the bigger the size of the crystals that developed. Potassium Dichromate and Copper Sulfate crystals grew in the porosities lower than 75%, but the Magnesium Sulfate did not grow at all. I concluded that the less matrix porosity the bigger the crystal. Matrix porosity has an effect to crystal development. Rocks with low matrix porosity keep solutions in the geode cavity and give time for crystals to develop.

#Second Award - Association of Women Geoscientists Foundation
Second Award - General Motors ISEF
Fourth Award - American Association of Petroleum Geologists

#A COMPARATIVE STUDY ON THE POSSIBLE EFFECTS OF SOME CLIMATOLOGICAL FACTORS OVER SERPENTINITE $(MgFe)_3Si_2O_5\ (OH)_4$ SOILS IN THE AREAS OF MAYAGUEZ, MARICAO AND CABO ROJO, PUERTO RICO

Maury, Javier, C.R.O.E.M H.S., Mayaguez, P.R.00709;
Cerro Las Mesas, Mayaguez, PR 00709.

My research deals with a study on how some climatological factors affect serpentinite soils in some areas in the southwestern part of Puerto Rico. This type of soil is very common in Mayaguez, Maricao and Cabo Rojo areas. I determined that the class and amount of soil nutrients vary as climatological factors change in those areas.

The soil analysis was performed by utilizing spectrographic semi-quantitative equipment and climatological factors were determined by observation and measurement. Additional data was obtained from previous research based on the last averages for thirty years.

The testing and further analysis revealed that soil and rocks studied from Maricao contained more nutrients than samples from coastal areas like Mayaguez and Cabo Rojo. It demonstrated also that heavy and prolongued precipitation causes extensive weathering in this type of soil. It was also determined that at a greater degree of aeolic force the least the weathering. The Cabo Rojo area showd no soil laterization due to the fact that conditions are not ideal for weathering and iron cannot pass directly to the soil as it happens in other areas studied.

#Honorable Mention - American Meteorological Society

A NEW TYPE OF GASOLINE MADE FROM COAL, Eric Wolfe, Abingdon
High School, Va., 24210---2157 Fairway Dr. Abingdon Va. 24210

This project involved two(2) major technical challenges: First, making the proper coal liquid-Naphtha mixtures and second, buring the fuel in a 5 HP Briggs&Strattion gasoline engine, which in most respects is quite similar to large scale V-8 gasoline engines. The combustion testing involved the use of a gasoline engine coupled to a dynamometer.

Based upon these experimental results, coal-liquid Naphtha mixtures equaled or surpassed premium gasoline at all tested percentages. It is also believed a 100% coal-liquid fuel could be successfully used. However, due to the lubrication properties of oiled-based Naphtha, it was observed that the viscosity of a mixture of coal-liquid and Naphtha had improved lubrication characteristics.

If a coal-liquid mixture could be used in the United States, particulary in car and naval marine type engines, this would either significantly reduce or eliminate need of foreign oil.

# ALGAL OXYGEN PRODUCTION IN A CLOSED ECOLOGICAL SYSTEM

Myers, Butch, Belle Fourche High School, Belle Fourche, SD 57717
Box 430, Belle Fourche, SD 57717

The systems presently in use for human life support in space require that food, water, oxygen, and that human wastes be stored. Lengthy missions or large crews will require large masses of consumable supplies that must be taken along or resupplied. Eventually, the regeneration of consumable supplies will be economically competitive with the cost of their initial transport or resupply.

A biological process that could be utilized for the regeneration of consumables is photosynthesis. Photosynthesis has the potential for carrying out most of the functions of a life support system: production of food, oxygen, and water, and the removal of carbon dioxide.

This experiment evaluated the oxygen production aspect of photosunthesis in certain types of algae. The algae that were chosen were Oscillatoria, Arthrospira, and Spirulina from the Cyanophyta phylum and Closterium from the Chlorophyta phylum.

This experiment was done in two phases using a water-displacement system to measure the oxygen output of the four types of algae. The first phase measured the overall oxygen production of the algae under near ideal conditions. Phase two of the experiment found the rate of oxygen output and determined which type of algae reached maximum oxygen output the quickest and sustained it the longest during a nutrition deficiency.

Oscillatoria was found to be the best algae to use in a closed ecological life support system as an oxygen producer. It had the highest overall oxygen output under near ideal conditions. It reached maximum oxygen output sooner than the other types of algae and sustained it longer than the other types. It also used nutrients at a slower rate than did the other types.

#Second Award - United States Air Force
Honorable Mention - National Aeronautics and Space Administration

THE TRACKING OF HALLEY'S COMET

Rendon, Richard, Nixon H. S., Laredo, TX 78040;
2719 Garfield St. Laredo, TX 78040

Basically what my project entails is the tracking of Halley's Comet. Research and data collecting began in September of 1985 and continued through to January 1986. My data included altitude and azimuth in degrees. From there I calculated the right ascension and declination. Once the above information had been calculated, distances could be found. The information presented in my project includes positions: altitude, azimuth, right ascension and declination for the sun relative to the comet and the comet relative to the Earth. Information entered bu user is latitude, year, month, day, hour, minute. That way the program can give up-to-the-minute and informative data used to find the Comet in the night sky.

#A COMPARISON OF THREE TEXAS ARCHAEOLOGICAL SITES

Sagebiel, Kerry L., Rockdale H.S., Rockdale, TX 76567
1708 Alcoa Street, Rockdale, TX 76567

PURPOSE: The purpose of this project is to compare three sites that vary in location, time periods, purpose and culture. The similarities and differences in artifacts found at these sites and methods used to unearth these artifacts are compared.

PROCEDURE: The methods to be used on each site had to be decided upon by either physically surveying the area, digging test pits or using a metal detector. One or more of the following methods were used at each site: pit, grid, surface or trench excavation. All artifacts were carefully excavated and then photographed, drawn and measured in situ. Information on each artifact was written on a card. The artifact was then removed.

RESULTS: The Wilson Pottery site has yielded mostly pottery made there from 1857-1869. Also ceramic, glass, metal and significant amounts of ash was found.

The Nashville site has yielded mostly metal, glass, pottery and ceramic since it was inhabited from about 1837-1868.

The Indian site has yielded mostly flint chips, bone, shells and ash. This indicates that it is a prehistoric site.

CONCLUSIONS: I have found that the methods best used at a site depend upon the type of soil, the location and the type of artifacts one is looking for.

I also concluded that each site was occupied by a different unique group of people.

APPLICATION: Results from an archeological excavation can be used to learn about the past of a particular area or humanity in general and can help us better understand ourselves.

#Third Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

EARTHQUAKE: WHOSE FAULT IS IT?

Farmer, Christopher N., Russellville H.S., Russellville, KY 42276
745 Rhea Blvd., Russellville, KY 42276

Knowing the location of faults and hypothesizing what would happen to areas around the fault in the event of an earthquake is important in many ways. It could help contractors determine safer sites for building factories, power plants and homes. It could also help in saving lives by discouraging settlements around the faults or by making people aware of the danger, thereby allowing them to find a place of lesser risk.

Earthquake faults have been located around the area of Russellville, Kentucky. They have been surveyed and put on geological maps. In my project, information was collected on the soil composition and underlying rock layers near the fault area. Survey maps were then used to construct clay models of the areas around the fault. Next, an apparatus was built that would apply pressure similar to that of an earthquake to the model. Before adding the pressure, the faults were simulated by cutting the clay in different areas. When pressure was applied to the clay the model reacted by buckling and cracking in a similar fashion to that of the earth's crust. In every instance, the models buckled in the area of the fault and caused the surrounding areas to rise or fall depending on the direction of the new faults formed. From this research the hardest-hit areas and the places on the map that would receive the most damage could be determined.

#COMPUTER-CONTROLLED APPARATUS FOR DETECTING INTERNAL GRAVITY WAVES IN THE IONOSPHERE

Stahl, Matthew R., Seguin H.S., Seguin, TX 78155;
3051 Woehler Lane, Seguin, TX 78155

The major scientific principle studied in the project concerned the design, construction, and implementation of a prototype microcomputer-controlled apparatus for detecting and tracking internal gravity waves in the ionosphere.

The main objective of the project was to utilize the computational and control capabilities of the Apple II microcomputer in controlling an apparatus for detecting those waves high above the earth's surface, which cause variations in the reflection of radio signals by the ion-rich layers of the earth's upper atmosphere. The waves cause periodic disturbances in the ionosphere and are thought to be generated by severe thunderstorms, the jet stream, and bombardment by solar particles.

The procedure and methods used to build the apparatus involved the construction of four separate but unified circuits under computer control. One of the electronic circuits built was used to detect and track the internal gravity wave signal from a modified transistor radio. A stepper motor positioned the ferrite-rod antennas of the radios in an optimum orientation needed to detect the waves. A voltage-to-frequency converter circuit was built to convert the analog wave signal into an audio frequency for storage on a magnetic tape. The tape was played back later and the audio frequency was converted back into a voltage. The signal was sent to an analog-to-digital converter which converted the voltage into a digital representation that the computer could process and graph. My conclusion was that a computer could be used to detect and graph an internal gravity wave signal.

#First Award - Sigma Xi, the Scientific Research Society

#WHAT A DRAG!

Brown, Stacey L., Clear Lake High School, Houston, TX. 77058
1103 Oak Circle, Seabrook, TX. 77586

Astronauts participate in neutral buoyancy (water immersion) simulations to train for tasks they will encounter in the weightlessness of spaceflight. However, these water immersion simulations involve hydrostatic (water) drag not present in space. To achieve a valid simulation of spaceflight, the effects of hydrostatic drag must be better understood and, if possible, quantified. The objective of this project is to measure the hydrostatic drag on the human body during water immersion simulation and to determine if there is a velocity at which the validity of the simulation is lost due to drag.

During the project experimental phase, velocities and corresponding drag levels were measured. Body segment dimensions were measured to determine projected front body area. During the project theoretical phase, the coefficient of drag was determined from experimental velocities and drag levels. Using the coefficient of drag and projected area, theoretical values for velocities and drag were calculated and compared with the experimental values. A plot of extended theoretical values was then constructed.

The coefficient of drag of the human body is experimentally determined to be approximately 5.5. The body coefficient of drag and the projected front body area permit calculation of theoretical drag acting on the human body moving at a given velocity. A close correlation exists between experimental and theoretical values of drag. Water immersion simulations are valid at low velocities where drag is small. There is no clearly defined velocity at which the validity of water immersion simulation is lost due to drag. However, as velocity increases, drag increases at a much faster rate. Other factors (e.g., type of task and task time) must be considered in assessing simulation validity at higher velocities.

#Honorable Mention - National Aeronautics and Space Administration

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#HOHOKAM POTTERY POROSITY

Wolf, Andrew J., Emily Gray Jr. H.S., Tucson, Arizona 85749
2547 Placita de la Lantana, Tucson, Arizona 85749

My project involves the testing of the porosity of pottery sherds. Testing the porosity of bowls as compared to pots may give us a clue to whether or not the ancient Hohokam Indians made pottery differently for different uses.

I believe that the pots will be more porous because the pots were used as water containers. A water container with a high porosity level would permit a film of water to form on the outside of the container, creating a evaporative cooler effect.

To test the porosity of my pottery sherds I did the following: Weighed the pottery sherds dry, submerged the sherds in boiling water for fifteen minutes, and weighed them again immediately after boiling. To find the actual porosity I put the dry and wet weight through the percent absorbed water equation.

$$\text{PERCENT ABSORBED WATER} = \frac{\text{WET WEIGHT} - \text{DRY WEIGHT}}{\text{DRY WEIGHT}} * 100$$

After testing all of my sherds I found that my hypothesis was incorrect. This may be because the bowls were used for cooking and not just for storage as I had first assumed. Bowls that were used for cooking would be more porous because bowls that have a higher porosity heat more evenly, thus heating the food more evenly.

#First Award - American Indian Science and Engineering Society

#Title: A New Method to Determine Magnitudes From Astronomical Prints
Author: Shiou-Jyh Ja
School: The Kaohsiung Municipal High School, 50, Chien-Kuo 3rd Road,
Kaohsiung, Taiwan, ROC(813)
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An easy and reliable method has been devised to determine magnitudes for astronomical objects in a photographic print. It is based on: (1) m=k*logI (magnitude is proportional to the logarithm of the intensity) and (2) x=c*logI (extinction depth in an absorbing medium also measures the logarithm of the intensity of a source), hence x(m) is a linear function.

We therefore place a photographic print between a light source and a container. Ink is injected into the container and the depth of disappearance for an astronomical object is recorded. Linear relationships are found for stars with known magnitudes which demonstrate that estimates using this method are accurate to 0.02 magnitude under favorable conditions. Two determinations of the magnitude of Halley's Comet at distinct heliocentric distances appear successful. They suggest that the increase of its luminosity with decreasing distances is faster for this return.

#First Award - Bausch & Lomb Astronomical Telescope Division
Second Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company
Honorable Mention - National Aeronautics and Space Administration

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#PREDICTION OF SEISMIC ACTIVITY THROUGH RADIO FREQUENCY EMISSION
Aho, Timothy A., Starkville High School, Starkville, MS 39759;
406 Chapin Street, Starkville, MS 39759

This experiment was designed to develop a new technique for the prediction and analysis of seismic activity. It is based on the hypothesis that certain rocks, when put under stress, release electrical energy in the form of radio frequency signals. This hypothesis was developed from the observations made by Dr. Brian Brady of the United States Bureau of Mines. Dr. Brady noted that plasma, a form of energy consisting of ions accompanied by a radio frequency emission, was observed while fracturing rock was photographed. Through scientific investigation, the existence of radio frequency energy emitted by stressed rock was confirmed.

As a second phase of this project, the source of these radio frequency emissions was sought. It was then discovered that plasma, due to the conditions under which it exists, might not be the cause of the emissions. Several other hypotheses were then developed to explain the presence of the radio frequency energy. One hypothesis, which was based on the Piezo-Electric Effect, seemed to be the most plausible. The Piezo-Electric Effect consists of electrical discharges produced by mechanical strain in certain classes of crystals. This hypothesis was tested, and the existance of a Piezo-Electric discharge which may be the source of the radio frequency emissions was confirmed.

#Second Award - Bureau of Reclamation/U.S. Department of the Interior
Alternate - Society of Exploration Geophysicists
Fourth Award - General Motors ISEF
Fifth Award - American Association of Petroleum Geologists

LONG-TERM SPACE PROBE FEASIBILITY STUDY

Lapp, Chris L., Monahans H.S., Monahans, TX. 79756;
P.O. Box 104, Monahans, TX. 79756.

PROBLEM: Is a long term space probe project feasible using today's scientific knowledge and technical advancements?

HYPOTHESIS: I believe that by combining different elements of different probes into a more advanced probe, that such a project is feasible.

PURPOSE: The purpose, to be able to reach farther out in our extraterrestrial search for life and information is determined by whether or not a probe that can do this is feasible.

PROCEDURE: I wrote to NASA and other aerospace and space probe manufacturing firms asking for information on their probes and the probes' instrumentation. After determining that the project was feasible, I compiled all of the elements into a more advanced probe of my own design to take better advantage of these features.

CONCLUSION: I have concluded that my design of the Long Term Space Probe is feasible. The only major setback is cost, which is estimated at 2½ times that of Viking 2. These costs are offset with the fact that the probe is long term and has renewable energy sources.

# STORAGE AND RECOVERY OF SOLAR ENERGY THROUGH THE HEAT OF SOLUTION OF SODIUM HYDROXIDE

Eastes, Wayne, Roy High School, Roy, UT 84067
5928 So. 3650 W. Roy, UT 84067

Through the use of the heat of solution of sodium hydroxide, I have been able to store and recover solar energy with very high efficiencies. Because the disassociation of sodium hydroxide in water is an exothermic reaction, it can be used in a storage system for solar energy. Through evaporation this storage system is recycled when the device is exposed to solar energy. This system can be operated on a 24 hour cycle, a two week cycle, or a biannual cycle, depending on the needs of the home.

This apparatus works by dripping water onto the sodium hydroxide stored in the chemical tub, thus causing an exothermic chemical reaction to take place. This releases heat which can be used to heat a home. When the reaction has gone to completion, the system is recycled when sunlight strikes the outside casing of the devices evaporating water from the solution. The water then condenses on the top of the device and collects in the water storage tank for future use. The cycle is complete and the device has stored energy in the chemical bonds for future needs.

Since this is a closed system device, it can be used in a home for storage of solar energy without a loss of water or sodium hydroxide, although some breakdown of the sodium hydroxide my occur after a long perid of time. This is a low cost system which provides an effeciency rating of about 70%. Once solar energy has been captured, it can be stored for indefinite periods of time. This is of particular importance in climates which have extended periods of ground fog and cloud cover during winter months.

#Alternate - United States Department of Energy

EXTRATERRESTRIAL RADIO MEASUREMENTS OF IONOSPHERIC ABSORPTION

Persons, Eugene L., Grand Rapids H.S., Grand Rapids, MN 55744
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The main objective of this study was to determine the following:

A. Does the intensity of a signal at a frequency of 30 mhz change with the daily altitude of the sun?
B. Does the signal intensity change monthly?
C. Are there seasonal variations in the radio signals?
D. Do extraterrestrial radio waves have any effect on northern light activity?

The investigator formed the following hypotheses:

A. The altitude of the sun will effect the intensity of measurement.
B. The radio signal intensity will change monthly.
C. There will be seasonal variations in the ionosphere.
D. The radio wave itself would have no effect on northern light activity.
E. Night activity would be slight, if any at all.

After careful study and analysis of the data was complete, the investigator concluded the following:

A. The altitude of the sun has no predictable effect on the daily measurements received.
B. There are monthly variations in the ionosphere, probably caused by the total amount of sunlight available and/or solar flares.
C. There are seasonal variations in the ionosphere that are related to total sunlight available and possibly solar flare activity.
D. Having observed no northern light activity during the time of the investigation, no conclusion can be made between the 30 mhz radio signal and northern light activity.

DEVELOPMENT OF AMPHIBIAN EGGS UNDER SIMULATED HYPOGRAVITY CONDITIONS

Leu, John Chin-Hung, Benjamin N. Cardozo H. S., 5700 223 St.,
Bayside, NY 11364;
69-11 179th St., Fresh Meadows, NY 11365.

The development of amphibian eggs (*Xenopus leavis*) under simulated microgravity conditions was studied. The simulation was done by constant low speed rotation on a horizontal axis (clinostat) at the eggs' isopycnic (bouyant) density. The density was determined by density gradient to be in the range of 1.0715 to 1.0975.

The range of densities of *Xenopus* eggs in single spawnings was found to be a 5% (0.0065) difference. The density range between spawnings was a 20% (0.026) difference. The densities of eggs with and without vitelline membrane was determined. Large percentages of eggs that rotated on the horizontal clinostat at their isopycnic density displayed a positive result (normal axis morphogenesis). The preliminary new observation that development of *Xenopus* eggs was delayed under the conditions of simulated hypogravity by subjecting the eggs to the clinostat at their isopycnic density was made.

#EFFECTS OF GRAVITATIONAL VARIANCE ON DOMICILE PREFERENCE

Jacobson, Alan L., Albemarle H.S., Charlottesville, VA 22901;
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The effect of zero gravity on humans has been studied because of its importance in future space colonies. These studies show that the effect of this zero gravity environment can prove to be detrimental. When studying the feasibility of such ventures as life on a space station, it becomes necessary to know how much artificial gravity must be produced, and for how long this gravity must be sustained.

When it becomes possible for man to live in a space station environment, what gravitational"pull" will be preferred? Does the fact that we are earthbound affect this preference?

To answer these questions, an experiment has been designed to simulate the effects of gravity on future generations born in an altered gravity state. This experiment studies the effect of artificial gravity, greater than one Earth gravity, to determine whether generations bred at higher gravity levels will prefer their "natural" gravitational environment, or a lower one.

The experiment uses Drosophilia due to their ability to reproduce at a rapid rate. A second generation, gestated, born and developed at two "G's" were allowed to choose whatever level of gravity they desired. Through the use of photography, the population density of the Drosophilia can be seen. In analyzing these pictures one can determine the gravity preference of the Drosophilia.

#Fourth Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

#VARIATION IN CRYSTAL HABIT OF PYRITE FROM OTOGE MINE

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Pyrite is one of the most popular mineral, and it shows various kinds of crystal habits. To clarify the relation between each habit and crystallization condition, the writer collected about 20,000 pieces of pyritic crystal in different parts of a vein, and classified them into nineteen forms of crystal habit, and then he etched the section of crystal by potassium permanganate and experimented on crystal growth with sodium chloride to clarify the effects of the cooling speed of the vein or the crystallization of other mineral on the growing crystal plane. From his observations and considerations, it is considered that the fundamental cause of the habit variations of pyrites is the differences of the conditions of crystallization environments. After all he took the following; pyrites in the inner part or in the deep part, which is cooled slowly, of a pyrite-stibnite-sericite vein are large and show complex octahedral habit or dodecahedral habit, pyrites in the outer part or in the shallow part, which is cooled quickly, are small and show simple cubic habit, and then the crystallization of other mineral, especially stibnite, on the growing crystal plane has a remarkable effect on the crystal habits; pyritic crystal taking with stibnite on its planes tends to have twenty-six planes: the number of planes is maximum the single crystal of pyrite can have. The above relations are saticfactorily interpreted from the standpoint of a new idea of crystal growth.

#First Award - American Association of Petroleum Geologists
Fourth Award - General Motors ISEF

#THE ROLE OF ELECTRICITY IN OUR ATMOSPHERE

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The purpose of my project is to make some preliminary categorizations as to the effects of differing types of electrical charge on selected atmospheric variables. I chose this particular branch of meteorology because of the relative lack of knowledge and considerable gains that could be made in a laboratory setting that exactly reproduced the variables that would naturally be present in the atmosphere during the phenomena in question. The reason that electrostatic cloud physics is more easily explored in a laboratory than in the natural atmosphere is because of the inherit difficulties in measuring and keeping track of your variables in a natural setting.

The procedure I used to explore the effects of a static charge on differing variables was to simply use an enclosed container in which I attempted to isolate all the unwanted variables as to make them unimportant in the experiment and then to apply the charge and take measurements of what could be measured and to observe those effects that were obvious.

The observations and data I have taken point to an obvious, though sometimes indefinite, effect of electricity on those atmospheric variables which I have tested. When all shielding effects have been taken out, one can then assume that a major and spontaneous change in the experiment was then due to your variable. This led to my conclusion: Electricity causes large, destructive, and spontaneous coalescence.

#Second Award - American Meteorological Society
Third Award - General Motors ISEF

# COMPUTER AIDED SEISMIC INTERPRETATION

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The purpose of my project is to develop a system that would make comparing day-to-day seismic activities easier than the strip chart method. This system utilizes the quick calculating abilities of a computer.

The first step was to construct a seismograph. After considering many designs, I decided on one that appeared in the July 1979 issue of Scientific America. This seismograph was developed by Jim Lehman of James Madison University. I made many modifications in Lehman's design to make it more suitable for my purpose. Under operating conditions the seismograph can detect anything above 4.8 on the Richter scale anywhere in North America and above 6.0 anywhere in the world.

The construction of the seismograph was a project in itself, but interfacing the seismograph and computer proved to be even more difficult. I finally accomplished this by attaching the pin of a Heath recorder to a game paddle. This arrangement may seem crude, but it was the most efficient way to convert the change in AC current to changes in resistance (which can be read by the computer).

The final step in my project was to develop software that could interpret the data and display it on the monitor. A hard copy of this program is included in my project.

My project took six months of work, but I feel the knowledge and experience has made it worthwhile. I hope my project alerts more people to the potential danger of earthquakes such as the one that created Reelfoot Lake in 1811-1812.

#First Award - Society of Exploration Geophysicists
Third Award - American Association of Petroleum Geologists

#IS THERE A BETTER WAY TO BUILD A SOLAR PANEL?

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In my experiment I tried to find a way to build a solar panel design that will produce more electricity than the more conventional design commonly used today.

I developed this idea from looking at a solar home in Canada and seeing that they were just collecting the sun that hit the solar panel. I decided to see if there was a better way to design a solar panel.

I proceeded to design and build three solar panels and a control panel patterned after the most commonly used solar panel. All of the solar panels were constructed identically in every way except their design.

The solar panels were then tested under various conditions of natural light and artificial light. I recorded the time, temperature and light conditions, DC volts, M.Amps, and Ohms that were being produced.

After all of the testing was completed, I used the formula: current equals resistance over efficiency ($I \frac{R}{E}$). The current (m.A.) was mathmaticonlly made to be 20; the resistance (Ω) found in each individual testing remained the same; the efficiency (v) became the only variable so testing results can be evaluated on a common scale.

In conclusion, there is a way to build a solar panel to yield more electricity then the control panel. The solar panel that utilized the magnification of light produced from two to three times more electricity than the control panel did under any lighting condition.

#First Award - United States Air Force

#THE MASS EXTINCTION OF THE PALEOZOIC ERA

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HYPOTHESIS

Is it possible to determine the major cause of mass extinctions that occurred in the Paleozoic Era by observing the various fauna of the time in relation to their ecology, lifestyles, and habitats to discover whether serveral factors such as environmental changes were involved in their extinction at the close of the Era?

PROCEDURE

1. Observe the various fossils of extinct forms of life in relation to one another.
2. Study the ecology of the time period to learn what role the environment played in the survival of various organisms.
3. Study the geology of the planet during periods of extinction to see if geological disturbances disrupted animal and plant habitats enough to be a factor in their extinction.

PRINCIPAL FINDINGS

1. Environment played a vital role in the survival of various organisms.
2. Many geological disturbances occurred during the Permian period.
3. Mass extinctions affected a wide variety of life.

CONCLUSIONS

By observing and studying the fossils of the Paleozoic Era, I came to the conclusion that the major cause of the mass extinction of the Permian period was due to several drastic changes in the environment, which occurred gradually not suddenly.

#Second Award - American Association of Petroleum Geologists

SINE WAVE POSITIONING OF JUPITER'S GALILEAN MOONS

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The purpose of this project was to find the postion of Jupiter's Galilean Moons, Io, Europa, Ganymede, and Callisto, at any given time. Charts of the position of the moons in the past were laid down in a vertical position. This showed that each of the moons formed a distinctive sine wave with Jupiter being the Y-axis. The next step was to determine the amplitude and period of each of the waves. This was done by discovering the distance of the moons from Jupiter and the period of each orbit. A computer program was then written to match the sine wave formula of each moon. The four individual programs were then transfered to one major program that, when ran, followed the sine wave formula of each moon and displayed the position of the moons as related to Jupiter at the given time.

#FURTHER ANALYSIS OF QSO NEBULOSITY

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Although it is now generally recognized that most, if not all, low-redshift QSOs are surrounded by some sort of nebulosity, the precise nature of this extended material remains a mystery. A more crucial understanding of the nature of QSOs and their correlations with underlying galaxies is desired. The importance of understanding the relationship between QSOs and their "host" galaxies lies in its implications both for the formation of QSOs and for the evolution of galaxies. The previous six year study indicated that low-redshift, low-luminosity QSOs existed in galaxies with a spiral morphology. To further elucidate the remaining QSO-galaxy enigma, the present investigation was delineated to expand and substantiate conclusions derived from the former study.

The previously undertaken investigation involved spectral analyzation of a QSO sample consisting of 10 objects. Constraints limiting the former study have been largely absolved, expanding the sample and applying new techniques coincident with those previously used, yet removing former limitations. Assuming, as research indicates, that the nebulosities around QSOs are in fact galaxies, the properties to be measured are the total luminosity of the underlying object, the distribution of luminosity (the morphology), radio/X-ray spectral index and morphology, as well as specific features of the spectra (nuclear and nebular observations). Through application of these means, it becomes evident that a sharp distinction can be made between certain objects of the sample, indicating two morphological types, possibly attributable to evolution and their state in life.

#First Award - General Motors ISEF
First Award - United States Army
First Award - United States Navy/Office of Naval Research
Alternate to Operation Cherry Blossom Trip - United States Army
Alternate to LIYSF Trip - United States Marine Corps
Alternate to Glenn T. Seaborg Nobel Prize Visit Award
Honorable Mention - National Aeronautics and Space Administration

KLUGE I: A PROTOTYPE MICRO-ROBOT TO AID THE PHYSICALLY IMPARED; Magri, Kristine, Liberal Senior High School, Liberal, KA 67901; 920 West First Street, Liberal, KS 67901

There are 240 thousand severely physically limited individuals in the United States today. The cost and quality of their care could be maintained by incorporating micro-robots into health-care facilities. KLUGE I, a prototype model for a low cost, servo, electric, personal robot of medium technological ability was developed. While KLUGE presently has a limited lifting capacity, its design is functional. Simple room rearrangements could allow KLUGE to be incorporated into present health-care facilities. Future plans call for incorporation of KLUGE into wheelchair designs.

C.A.R.M.: COMPUTER ACTIVATED ROBOTIC MOBILITY
Smith, Marek K., Heritage High School, Lynchburg, VA 24502
223 Wayne Dr., Lynchburg, VA 24502.

A three-axle parabot was constructed and the movement of the craft can be controlled by a computer program within the craft. The robot is powered by two 12 VDC windshield wiper motors. These control the drive and steering wheels which are separately operated. An isolated rotating pivot wheel is placed at the back of the frame for stability. A 12 VDC Deep Cycle battery powers the craft. The motors are controlled by a Timex Sinclair 1000 micro-computer. It contains a Z80 micro-processor with the needed address and data buses. The same battery, with some slight circuit modifications, is used to power the computer. A "power card" was constructed which allows the computer to control four relays that hook to the motors. An interface was needed between the TS 1000 and the "power card." This was accomplished by using an 8212 input-output port along with the appropriate port selection circuit. By poking 1, 2, etc. to the address port, relays 1, 2, respectively, will be turned on. This can control the forward, reverse, and turning of the craft. The robot can now be directed through a pre-programmed path and can carry out this task without human interference.

DEVELOPMENT OF AN ELECTROSTATIC PRECIPITATOR FOR AIRBORNE POLLEN REMOVAL

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An electrostatic precipitator uses static electricity to remove particles from air. Particles moving through it acquire a positive charge from positively charged electrodes, then are attracted and trapped by negatively charged electrodes. Both the particles introduced and the design of the precipitator influence the number of particles that the precipitator can collect. The purpose of this study is to investigate the effect of changes in an electrostatic precipitator on its ability to remove airborne plant pollen. The hypothesis is that the amount of pollen that the precipitator will remove from air will depend on its configuration and voltage and on the type of pollen being removed. An electrostatic precipitator was assembled from Plexiglas. A greased slide was used to collect unprecipitated pollen for indirect determination of the precipitator's collecting ability. The apparatus was assembled both horizontally and vertically and with and without vanes upstream from the positive electrodes. The voltage applied to the electrodes and the amount of pollen introduced were varied. The pollens of short ragweed, *Ambrosia elatior*, and timothy, *Phlenum pratense*, were used. Each series of trials was conducted using both pollen species. The vanes installed before the positive electrodes produced a reduction in the amount of ragweed pollen precipitated but produced no difference in effectiveness of timothy pollen removal. As voltage applied to the precipitator electrodes increased, removal of both pollen species increased. Several modifications, including the use of vanes and the addition of an electrode cleaning system are recommended to make electrostatic precipitators more effective for airborne pollen removal.

DESIGNER 3.0: A 6502-BASED CAD/CAE SYSTEM APPLICABLE TO AEROSPACE DESIGN

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Model rocketry is a rewarding and interesting hobby; however, like anything can be improved to become more purposeful. Building rockets from mere ideas can prove to be both time consuming and expensive. This is also a problem for the larger aerospace manufacturers. How do they solve this problem? They possess integrated CAD/CAM/CAE (Computer Assisted Design - Computer Assisted Manufacture - Computer Assisted Engineering) applications. The MODEL ROCKET DESIGNING UTILITIES 3.0 is that application for model rockets. It provides versatility and accuracy, the major ingredients for a data base utility. The program is composed of approximately 640 lines of BASIC instruction. The 6502-based Apple personal computer is the required system for the programs operation. The designing utilities are a seven program, menu-driven, chain-linked program. Within the structure, RAM-SAVE techniques are used to limit the amount of input needed.

The DESIGNER program is responsible for the success of the Alpha, Beta, and Gamma test rockets. The subjects were each launched three times. The static test provided information proving that the DESIGNER 3.0 program was 95+% accurate in its altitude predictions. (NOTE: The predictions are for the Antlers, Oklahoma elevation of 500ft above sea level.) Correspondence with several leading aerospace companies yielded information concluding that DESIGNER-type programs are an important part of today's engineering industry.

#Second Award - American Astronautical Society

ROBOTICS: PHASE III-SPEECH SYNTHESIS, SPEECH RECOGNITION AND MOBILE MICROCOMPUTER CONTROL

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R. R. #1, Churubusco, IN 46723

The purpose was to construct a microcomputer controlled robot with a single manipulator capable of object retrieval. The robot is capable of being preprogrammed to carry out specific functions and moving objects from starting points to destination points.

In Phase I, the robot was manually controlled. Switches were used instead of computer relays. Several a.c. motors were employed. The manipulator was capable of grasping, releasing and 60 degree arm sweep and pitch.

In Phase II, the robot was computer controlled but not mobile by programming. The manipulator was inoperative.

In Phase III, the preprogrammable robot is capable of being mobile. It can move freely around a building, grasp objects, lift objects, roll objects 360 degrees, and release objects when commanded. Voice synthesis is available. Voice recognition is still being developed.

Future plans include voice recognition to control the robot, addition of an elbow, and addition of an arm yaw.

# ACHIEVING LOWERED WINDOW HEAT LOSS THROUGH APPLIED GAS-VACUUM TECHNIQUES

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Recently, the window industry has introduced a fairly new concept in high-end energy savings - the Heat Mirror. The Heat Mirror employs a thin layer of zinc to pass visible wavelengths of light, yet reflect theinfrared region of the spectrum. This method transmits 90% to 97% of the incident light.

This project proposes to develop a new type of window, a triple pane dual chambered design, employing an infrared absorptive gas in one chamber, and air under reduced pressure (a slight vacuum) in the other. Using structural supports, it is possible to achieve favorable results using standard double strength glass.

Accumulation of data from a complex, homebuilt test apparatus was handled by an IBM-PC outfitted with a 16 channel analog-to-digital converter. Stress photos were also taken through cross-polarization to reveal stress concentrations.

Best test results were achieved using helium as the IR absorber under partial pressure coupled to a vacuum in the second chamber. This yielded a R-value of approximately 5.1 as compared to 1.0 for air in both chambers. As can be seen by this test, and many others on which data was collected, this window does work and could be a possible alternative window in the future.

#First Award - American Intellectual Property Law Association
First Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society
First Award - United States Department of Energy
Second Award - General Motors ISEF

SOLAR CELL EFFICIENCY ENHANCEMENT USING A FRESNEL LENS

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The problem was to determine whether a fresnel lens would increase the efficiency of a solar cell. It seemed logical to use the light intensifying capabilities of the fresnel lens to brighten the light striking the surface of the solar cell. This intensification would increase electrical production and make the cell more practical and efficient. The first step was to determine what effect the lens had on various elements. This test gave an indirect indication of the focal points temperature, thus providing information for the placement of the cells in the focal point area. Specific placement would prevent the lens from burning a hole in the solar cell. After correct placement was determined, an apparatus was constructed to keep the lenses and solar cells in constant alignment with the sun. The apparatus required wood, aluminum and electrical supplies, mainly a motor and its accessories. After the apparatus was completed, tests were taken to determine the percentages of increase that the lenses inflicted upon the solar cells. Tests were taken during cloudy and clear days. The tests revealed 47 percentages to 120 percentages increase in electrical production when using two lenses with the solar cells. From these experiments, I have concluded that incorporating fresnel lenses with solar cells is an advantage. This action may guarantee the solar cell a place in technology.

TWO-YEAR STUDY OF HEAT EFFICIENCY IN AN EARTH-SHELTERED HOME

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Last year's research proved an earth-sheltered home is more heat efficient than a conventional home. This year's research was done to see if the type of soil surrounding the earth-sheltered home affects the temperature and heat efficiency of the home.

To start experiment, three identical miniature houses and three larger houses were built out of ¼ inch plywood. A small house was set inside each larger house. Three types of soil: clay, loam and sand were collected. One type of soil was placed between each small house and each large house. An electric candle was placed inside each of the three smaller houses with a thermometer. A fourth thermometer was placed on a tree beside the houses. All thermometers were checked daily for 24 days.

The hypothesis was an earth-sheltered home surrounded by clay will be more heat efficient than an earth-sheltered home surrounded by sand or loam.

The results of the temperature experiment for 24 days revealed the following average temperatures: 36°F., ambient temperature; 49°F., house surrounded by clay; 49°F., house surrounded by loam; 46°F., house surrounded by sand.

Based on this research the hypothesis must be rejected because the temperature experiment did not prove clay to be significantly more heat efficient than loam or sand. Further research is warranted to test prolonged freezing temperatures vs heat efficiency.

# THE EFFECT OF EXPANSION ANGLE ON THE PERFORMANCE OF WIND-TUNNEL DIFFUSERS WHICH TRANSITION FROM A SQUARE TO A ROUND CROSS-SECTION

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Low speed tests were conducted on three small-scale models of diffusers designed for use on an open-return type wind tunnel. The investigation was prompted by some difficulties encountered in the operation of a small wind tunnel (known as the "LVART") used at the NASA Langley Research Center. According to the published literature, a diffuser expansion angle of 7° or less should result in good diffuser performance, but the 6° diffuser on the LVART works very poorly. The effective expansion angle is the main factor affecting the performance of diffusers which have a constant cross-sectional shape; the purpose of this experiment was to examine the effect of diffuser expansion angle on the performance of diffusers which transition from a square to a round cross-section, as is often the case for a wind tunnel.

Three diffusers were designed for testing, with diffusion angles ranging from "good" (4°) to "marginal" (7°), to "poor" (10°) based on published guidelines. The 10° diffuser could also be fitted with a simulated motor nacelle to measure the effects of nacelle blockage. The exhaust-to-inlet area ratio was 1.5 for all three diffusers. Tests consisted of measuring the exit-plane velocity profiles for a model test section, and for each of the diffusers. The average test-section velocity was 40 ft/sec for all tests.

The results of the experiment showed that significant separation was present in all three diffusers. The data lead to the general conclusions that adherence to published design guidelines for diffuser geometry does not necessarily ensure good diffuser performance, and that diffuser performance is sensitive to the velocity profile at the diffuser inlet.

#Third Award - American Astronautical Society

# DEVELOPING THE PADDLEWHEEL WINDMILL

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The long term objective of this study is to develop a horizontal axis, upwind windmill that uses the vertical lift of ordinary airfoils arranged in a paddlewheel formation to produce rotational motion. The steps involved in achieving this goal have been separated into the following three phases:

1) Testing airfoils for their coefficients of lift.
2) Testing 4-bladed, 6-bladed, and 8-bladed windmill designs.
3) Testing air dams to determine whether or not they can be used to increase windmill output.

This year, I have primarily concerned myself with the testing of airfoils for their coefficients of lift. This has involved making several different airfoils out of styrofoam blocks, constructing a wind tunnel, and developing a measuring device that can be used to accurately measure the lift produced by the airfoils at angles of attack ranging, in increments of 5°, from 0° to 45°.

The progress of my research was slowed by difficulties that arose when developing the measuring device. Negating the effects of friction on the measurements, finding a way to securely attach the wing mounts to the airfoil, attaching the scale to the airfoil without disrupting the laminar airflow about the wing, and accurately measuring the angle of attack are a few of the problems to which solutions or compromises had to be found before testing could begin. By using principles of physics, common sense, and a touch of ingenuity, I believe I have ended up with test results that have an accuracy that allows conclusions to be drawn from them.

#Alternate - United States Department of Energy

#FLY ASH FOAM: A METHOD TO CREATE A CERAMIC MATERIAL FROM THE WASTE PRODUCTS OF COAL INCINERATION, THROUGH THE USE OF MICROWAVES

Horton, Caroline K., Grand Blanc H.S. Grand Blanc, MI
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Coal fired heating and electrical generating facilities produce a large quantity of the waste material fly ash. My project, which was based on preliminary work done at the Los Alamos National Laboratories, produced a very strong, lightweight foam from fly ash. To produce this fly ash foam, I developed a solution composed of eight parts sodium silicate and one part fiberglass resin. When I added 90ml of this sodium silicate-fiberglass resin solution to 40g of fly ash and then microwaved it, a very light, strong ceramic foam was produced. In order to produce uniform shapes, I cast my foam in fiberglass molds prior to microwaving them. The foams I produced were waterproof and more durable than those produced at the Los Alamos National Loboratories. Because of the variety of applications that this foam has in the construction and insulation industry, the director of ceramics at the Los Alamos National Laboratories has encouraged me to apply for a patent, whcih I am in the process of doing.

#First Award - General Motors Corporation
Second Award - American Intellectual Property Law Association
Second Award - Junior Engineering Technical Society
Fourth Award - General Motors ISEF

PORTABLE SECURITY SYSTEM

Chris Ryan, Hamilton Heights H.S., Arcadia IN 46030
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This portable security system was designed to protect and give a sense of security to people while traveling. This device can be used in a motel room, camper, or car. The system is completely self-contained, consisting of a magnetic trigger and a battery powered alarm circuit. The system was designed to utilize inexpensive adhesive strips to attach the transactor to the door jam and the alarm to the door. The circuit was designed with a time delay feature to allow entering the room without activating the alarm.

The alarm circuit consists of two relays, a 555 timer chip which utilizes a resistor-capacitor circuit, and a buzzer all mounted on a printed circuit board. The time delay is based on the slow charging of a capacitor through a resistor. The 555 chip compares the charge on the capacitor to the supply voltage. When this charge is equal to two thirds the supply voltage, a silicon gate is opened, turning off the output voltage. The two relays act congruently to prevent the buzzer from sounding during the time delay and then to sound the buzzer after the time delay.

The length of the time delay is adjustable from almost instantaneous to a delay of approximately 15 seconds. This is accomplished by varying the resistance in the resistor-capacitor circuit by a potentiometer.

This system is compact and effective. It is also inexpensive since it is constructed of readily available, stock components. It is believed that this device is marketable because of its low cost and usefulness.

* MEMBRANES IMPROVE INSULATION EFFICIENCY

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It has been determined from extensive testing of temperature gradient and heat transfer through attic insulation that fiber insulation materials do not function as expected. It has also been determined that small scale tests (e.g., "Guarded Hot Plate" per A.S.T.M. C-177) which are used to determine thermal resistance "R" and thermal conductivity "K" constants do not accurately predict the performance of fiber insulation in homes.

If various moisture permeable membranes are placed over and intermittently through the insulation, the heat flux (rate of heat transfer) can be reduced by 50% to 70%. This is due to reduction in convection air currents which exist in the insulation.

The most effective material tested to date is a white perforated polyethelene which used TiO_2 as a pigment. This material shares similar properties with materials such as aluminum foil. The perforated membrane, like aluminum foil, reflects radiant heat back into the attic during summer and into the insulation and building during winter. The material also reduces convection currents in the fiber insulation as was stated earlier.

Tests have also been conducted to determine moisture content in the fiber insulation with and without membranes. In all cases, moisture content is reduced if membranes are used in conjunction with the insulation.

Two patents are pending on this method of insulating homes.

#First Award - Allegheny International
Second Award - Ball Electronic Systems Division and Ball Aerospace Systems Division
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Third Award - American Intellectual Property Law Association
Third Award - General Motors ISEF

LIFT AND DRAG IN AIRFOILS

Carlson, Eric P., Woodbridge Senior H.S., Woodbridge, VA 22192
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The purpose of my experiment was to find what degree of camber in a two-dimensional, infinite span wing with constant chord, gives the best lift to drag ratio.

The experiment was a comparison between four test wings. The wings were constructed on the basis of three variables. The chord, the distance of the maximum camber (thickest part of wing) from the front of the wing, and the length of the maximum camber. The length of the maximum camber was the only variable that changed. The four wings were each tested at three different angles of attack, zero, twenty, and forty degrees. The wings were tested in a wind tunnel of my own design. The tests were a comparison, so an arbitrary scale of equal units was used. Simultaneous measurements of lift and drag were taken. Tests were performed five times for each angle of attack.

The results of the tests were similar to my hypothesis. At low angles of attack the median wings had the best lift to drag ratio. As the angle of attack increased, the lift hit a peak and then dropped rapidly. At extremely high angles of attack most of the lift was probably caused by deflection because all the wings had similar lift. A fifth more larger wing was probably needed because the fourth wing had not defined an upper limit to the pattern created by the lift to drag ratios.

#MULTILAYER DIELECTRIC MIRRORS

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This optics experiment deals with the manufacture and testing of multilayer dielectric mirrors, high quality front surface mirrors for use with lasers and other optical experiments. One of the basic physical principles of mirror reflection is that when light strikes any surface a percentage of it is absorbed, reflected, and transmitted through the material. For a multilayer dielectric mirror; however, absorption and transmission are kept at their lowest possible values; therefore, all the remaining light is reflected. Absorption of light by a piece of glass substrate is a small fixed value, (approximately .01%), so the amount of reflection is inversely proportional to the amount of transmission. A high amount of reflection can be attained by coating a glass substrate with alternating layers of materials which have high and low index of refraction. The index of refraction "n" is defined as the ratio of the speed of light in vacuum to its speed in a given medium. The key concept to understanding why such a high reflectivity can be achieved lies in wave mechanics, mainly in the principle of interference. Each added layer produces reflections every time the light changes medium. Each layer is one-fourth a wavelength thick so light waves are reflected back in phase with waves from other reflections. Since the reflected waves are in phase, they constructively add upon each other. The more layers, the more reflections which results in higher constructive interference. Because the construction of mirrors deals with fractions a wavelength of light, (5×10^{-7} meters), every unwanted molecule is an impurity which lowers the precise reflectivity of the mirrors. It is therefore necessary that the production of mirrors take place in a high vacuum chamber, (less than 10^{-5} torr).

#First Award - Vacuum Technology Division of the American Vacuum Society
Honorable Mention - Optical Society of America

NONLINEAR OSCILLATION TRAJECTORY STUDY
- A NOVEL APPROACH TOWARDS THE DYNAMIC BEHAVIOR OF PENDULUMS -

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4 Allan Terrace, Secaucus, N.J. 07094

Nonlinear oscillations have been important subjects in the many fields such as engineering, physics, and applied mathemathematics. With the advent of powerful computers, it becomes possible to examine these oscillation problems in a very effective manner through a numerical method.

The objective was to examine the dynamic behavior of nonlinear oscillatory systems such as pendulums with impact balls through a numerical procedure.

The fascinating patterns of oscillations observed in nonlinear pendulums with impact balls were thoroughly examined to clarify the inherent characteristics. Based on these results, computer simulation models were developed and validated by actual observations of the pendulum. Futhermore, Lissajous patterns were produced on the computer from double pendulum trajectories, which were subsequently extended to create a series of artistic computer graphics.

In addition, a further effort was made to examine an anchored ship off-shore, and a barge being towed through water, which are some of the largest examples of the pendulum-like systems.

It is clearly evident in these results that a computer-based numerical method is a powerful tool to examine complex oscillatory systems in a very effective manner.

#Fourth Award - General Motors ISEF

DIJI ARM - COMPUTER DRAWING AID FOR PRIMARY SCHOOL USE

Tang, Wah, Whitefield School, Claremont Road, London NW2 1TR, UK;
55 Limesdale Gardens, Edgware, Middlesex, HA8 5HZ, UK

Primary school children when using micro-computers find it hard to produce drawings and pictures as they lack the knowledge of computer programming. The Diji Arm was designed to simplify this process.

Using the Diji Arm primary school children are able to trace their pictures and maps very easily. Various functions are available to help the children such as a rubber banding routine to draw straight lines and a circle routine for curves.

In addition to being a drawing device, the Diji Arm can be used for interactive learning; a child can use the arm instead of a keyboard to answer questions programmed by the teacher. The subject of the questions could be altered to develop skills such as telling the time, counting, spelling etc. This would be very useful as a means of introducing young children to computers.

Because the Diji Arm was designed for primary school use, it was decided that it should be produced as a kit which could easily be fitted together. Colour-coded information cards are supplied for assembling and using the arm.

Diji Arm is designed for use with the Acorn BBC micro-computer which is used in most British primary schools.

EVALUATION OF STRESS CONCENTRATION FACTORS USING HOLOMETRY

Oyler, John V., Mt. Lebanon High School, Pittsburgh, PA 15228;
92 Youngwood Road, Pittsburgh, PA 15228.

The purpose of this experiment is to apply holographic interferometry (holometry) to evaluate stress concentration in the vicinity of discontinuities in flat plates subjected to in-plane stresses. Holometry provides the capability of measuring nanometric (billionths of a meter) dimensional changes in the surface of an object by using a double exposure technique. A holographic exposure is made of the object while subjected to load and a second exposure made of the same object with the load removed. In the resulting hologram the surface of the object is covered by a series of interference fringes each of which represents a dimensional change of 0.168 millionths of a meter. A variety of discontinuities were studied--circular holes of different diameters, fillets, and semi-circular edge cutouts. Two methods were utilized to apply stress to the specimens--constrained thermal expansion and mechanical loading using a system of pulleys. Holometry was used to evaluate the transverse strain, and the Poisson effect and Young's modulus used to calculate in-plane stress distribution throughout the specimen. Stress concentration factors were found by comparing stress immediately adjacent to a discontinuity to the nominal stress at a distance from it. Results obtained compared favorably (within 3%) with classical results determined by Peterson and Frocht. This technique has unlimited potential for the determination of stress concentration factors for a wide variety of discontinuities.

#First Award - American Astronautical Society
First Award - Eastman Kodak Company
Second Award - General Motors ISEF
Second Award - Society of Photographic Scientists and Engineers

IMPROVING THE AERODYNAMIC EFFICIENCY OF HUMAN-POWERED VEHICLES, PART II

Brown, Phillip P., Woodbridge Senior H.S., Woodbridge, VA 22192
2703 Woodfern Ct., Woodbridge, VA 22192

Modern human-powered vehicles are extremely inefficient. Their basic design has remained virtually unchanged since the late 1800's. Much of the cyclist's power is used simply to push air out of the way. The object of this research was to determine what effect an aerodynamic shell would have on the efficiency of a human-powered vehicle. Research performed in a homemade wind tunnel showed that a blunt teardrop with a long, drawn out tail creates much less drag than one which widens gradually and tapers to the tail relatively quickly. This fact led to the design of a blunt, long-tailed shell to be used on a custom designed and built tricycle. The researcher designed and built the test vehicle, a tricycle, the basic frame of which came from an industrial tricycle. The pedals and seat were moved forward, gears were installed, and an entirely new steering system was added. These modifications resulted in a sturdy, low-to-the-ground, recumbent vehicle. The aerodynamic fairing consisted of a metal and wooden frame covered with smooth clear plastic. This entire structure was seated over the actual vehicle and test runs were made, both coasting downhill and powered, with and without the fairing, along a course of known distance. The speeds achieved in this manner were compared. The tricycle when pedalled without the shell reached a top speed of 24.91mph; with the shell, the researcher attained a speed of 34.47mph. Use of the fairing increased the maximum speed by 38%.

# COMPUTERIZED SONAR EQUIPPED SENSORY ROBOT

LeGrand, Richard, Edmond Mid-High, Edmond, Oklahoma 73034
1217 Cedar Ridge Road, Edmond, OK 73013

Two years ago, I developed a different robot that had many small problems. These problems gave new ideas for a future robot. This robot would have many sensory functions enabling it to operate independently unlike the previous robot.

Construction started with the mobile platform. The platform had to maneuver in several directions and return data to an onboard computer about its movements. Next, an interface capable of receiving and transmitting data and addressing chosen circuits was built. The interface also had to be expandable for future additions. The first circuit to be interfaced was an allophone based voice synthesizer. The voice synthesizer would output information needed by the user. Secondly, the voice recognition circuit was constructed which served as a convenient inputing device. This circuit could recognize eight words programmed by the user. The third circuit designed was the motor control circuit. This circuit had to control the direction and speed of the motors and inform the computer on each wheel's position. The next circuit I made was the sonar circuit that could "see" objects in the platform's path and control the direction of sight with a stepper motor. To complete the robot, the software was written which incorporated all circuits and allowed the robot to operate independently.

With all circuits operating properly, the robot performs independently by using data processed by the computer. It can move while avoiding objects in its path as well as follow instructions inputed by voice. Future expansions may include a robotic arm and a wireless keypad.

#First Award - National Aeronautics and Space Administration
Fourth Award - General Motors ISEF

#HOW CAN HIGHER FUEL EFFICIENCY BE ACHIEVED IN AN INTERNAL COMBUSTION ENGINE? Slattery, Rodney, Sallisaw High School, Sallisaw, OK 74955; Route 3, Box 231, Sallisaw, OK 74955.

The purpose of this experiment was to determine if higher fuel efficiency could be reached without a loss in horsepower, or damage occurring to the small engine due to predetonation.

The procedure was to use the standard carburetor that came with the engine as a control. This carburetor was slightly modified by the addition of a tunnel-ram. A completely different carburetor was built with high fuel efficiency as its goal. The systems were tested at 2000 revolutions per minute for twenty minutes. The experiment tested the amount of fuel consumed under these conditions.

The standard carburetor consumed five ounces of fuel. The tunnel-ram system consumed four ounces of fuel. The highly efficient system consumed two ounces of fuel, yet it was inefficient in itself. It was tested again with a few modifications, and only consumed .9 ounces of fuel.

The adjusted highly efficient carburetor was 555% more efficient than the standard carburetor. A comparable carburetor on an automobile engine would more than multiply its gas mileage by five. Imagine a car that needed an oil change every time the gas tank needed to be filled.

#Alternate - United States Department of Energy

#DESIGN, CONSTRUCTION AND OPERATION OF A CONTINUOUS-PULSED ION BEAM ACCELERATOR
Jacobs, Stephen M., St. Thomas More H.S., Hamilton, Ont.
L9A 2Z8 10 Terrace Dr., Hamilton, Ont., L9A 2Y6

Sparked by a visit to a linear accelerator laboratory, stimulated my interest in high energy particle physics.
With this interest, I became very curious to see if I could build a small accelerator of my own. Two years ago, I began to initiate certain steps for acquiring parts, tools, and research papers. Following the accumulation of parts (materials lying around the house, and at various shops) the construction began based upon structural limitations and efficient use of materials. The accelerator was completed, properly shielded and made ready for operation. The ultimate purpose of this project is three-fold:

1. Choosing the best possible accelerator design, based upon present structural data on various types of accelerator designs.
2. Constructing an accelerator from odds and ends, machined parts and previously designed parts. The construction was such that it offered a maximum versatility for a host of different experiments.
3. Operating the accelerator safely and efficiently during various test and runs.

This accelerator is presently being prepared for a host of experiments to be conducted during the Summer for a local university. Experiments to be performed include proton crystallography, thermal neutron production using (d,t) reactions, and a new idea for treating internal and external cancers which is presently being considered by the Henderson Cancer Institute and clinic in Hamilton.

#First Award - General Motors Corporation
First Award - Vacuum Technology Division of the American Vacuum Society
Third Award - General Motors ISEF

* COMPUTER CONTROLLED ROBOTICS

Milde, Michael N., Riverside H.S., Greer, SC 29651
115 Creekside Rd. Greer, SC 29651

The purpose of this project is to investigate the possibility of using a computer to find and sort randomly placed objects that might be involved in a manufacturing process.

A robotic arm controlled by a home computer was constructed and used for this purpose. The arm moves on a plane and a gripper picks up objects that can be taken to other locations as determined by the computer.

Machine language and BASIC programming provide the necessary instructions to control the robot. The programs send signals from the computer to a circuit. Several problems had to be solved, such as isolating the computer from the rest of the project, raising the current from CMOS to TTL, controlling the driver chips, the stepper motors and gripper.

A photo-cell on the end of the arm provides a feedback loop to the computer to determine where the objects are on the platform. Matching the available stepper motor torque to the inertia of the robot parts was also necessary.

Test results show that the computer controlled robot is much more accurate and reliable than a human.

*Fourth Award - General Motors ISEF

THE EFFECTIVENESS OF WEGS?

Glorioso, Maurice F., Resource Learning Center H.S., B'ham
1865 Tall Timbers Drive, Birmingham, AL 35226

WEGS is a scientific acronym for Wind Energy Generating System or windmill. In the near future, there will not be the large deposites of fossil fuels that exists today. This is due to the unsparingly manner in which this world uses them. Therefore, it will be necessary to study other sources of generating electricity, especially ones that are not harmful to the earth. The time to begin researching these methods is now. The purpose of this project is to make a close examination of wind energy as an energy source. Both types of WEGS, which are horizontal axis rotors and vertical axis rotors, will be tested to determine which is more effective in the generation of electrical energy.

I hypothesized that the horizontal axis rotor would be more effective in the generation of electricity, based on comparisons of tip speed ratios of both WEGS. Next, research was conducted into the physical operations of WEGS, their design, and coefficient of power. Hense, scale models of real WEGS could be built to test the hypothesis. The experiment would be a fair test of both WEGS under the same conditions. Using a small generator and D.C. voltmeter, it was possibile to determine that the horizontal axis rotor generated approximately 0.8 of a D.C. volt, whereas the vertical axis rotor generated approximately 0.2 of a D.C. volt. It was also noted that at lower wind speeds, the vertical axis rotor was less effective in the generation of electrical energy than the horizontal axis rotor.

In conclusion, it has been proven by this project that the horizontal axis rotor WEGS is more effective in the generation of eletricity than the vertical axis rotor WEGS.

# VACUUM DISTILLATION OF WASTE OIL, CRUDE OIL, AND ALCOHOL

Kannas, Terry G., South Shore H.S., South Shore, SD 57263
RR 1 Box 37, South Shore, SD 57263

There are more than one billion gallons of oil used in the United States per year. Only about 100 million gallons reach the recyclers to be refined. The rest is disposed of or burned as fuel.

This gave me the idea of making a small scale waste oil recycler. In my first phase of research I constructed an atmospheric pressure still with glass marble packing. The result was that the temperature in the column was too high at 400°C which caused cracking of the lubricating oil into fuel oil with shorter molecules, lower viscosity, and poor lubricating properties. In my second attempt I used stainless steel turnings as my packing material, which increased the surface area by more than ten times, and a vacuum pump from a refrigerator to bring down the pressure in the still to about 40 mm of mercury. Using this method the oil was only heated to 300°C. This did not cause the cracking observed in phase one.

The third phase consisted of vacuum distilling Wyoming crude oil into the various fractions. Boiling and pour point temperatures were taken on the fractions to try to identify the different products. Boiling points ranged from 50°C to 370°C at about 40 mm of mercury pressure. Pour point temperatures ranged from -110°C for the first fraction to -5°C for the last fraction.

In the fourth phase I distilled 12% alcohol to a high proof alcohol fuel using vacuum and very little heat. In conclusion I learned how to make a still that distills waste oil and crude oil under vacuum with no cracking and alcohol under vacuum with little heat applied to the still.

#First Award - Vacuum Technology Division of the American Vacuum Society

#TREE INJECTOR

Whittingham, C David, Trent College, Nottingham, Notts NG10 4AD, UK
'Copperfield', Foggothorpe, Selby, N Yorks, UK

A compact, safe and rapid method of treating disease, pests and mineral deficiency in trees, involving the injection of remedial solutions contained in thermo-plastic capsules. The capsules are easily charged with the required treatment and loaded into thermoplastic projectiles approximately 10mm in diameter which are fired into the tree using a specially adapted captive bolt cartridge hand gun. On penetration of the tree, the capsule is pierced by a needle which also serves to seal in the solution being administrated. At the point of maximum penetration the projectile carrying the treatment dosage is ejected by the gun and deposited within the nutrient-carrying fibres, where the specially designed capsule discharges its contents. Measured dosage of various treatments can easily be prepared, and can be carried by one operative travelling on foot, thus making the device particularly suitable for systemic pest control in commercial plantations normally difficult and costly to treat by methods at present in use, one operative being easily capable of treating 500 trees per day. With current research into the problems posed by acid rain, Dutch Elm disease and other environmental and natural enemies of both comercially valuable trees, the system offers an economical, precise, safe and rapid means of treatment of many woodland ailments.

#First Award - General Motors ISEF
First Award - Junior Engineering Technical Society

SMASH-CRASH-NO MORE TRASH, Rusty Allen, Battle Mountain High School, Minturn, Colorado 81645, 981 ½, South Main Street, Minturn, Colorado 81645

My experiment was to design an efficient trash compactor which was strong enough, small enough, and inexpensive enough for use in a car.

My first test was designed to see what kind of litter is hardest to crush. For this test I used a drill press with a scale on its base. I measured how many pounds of pressure it took to crush the material. I found that glass bottles were by far the strongest holding 360 pounds of pressure before breaking.

The second test was to see if the bottle would break easiest straight up and down, at a slant, on its side, or upside down. For this test I used a metal can connected to a table. Connected to the can was a pole going to a 5 gallon bucket in which I added weight. I determined that the bottle broke easiest either straight up and down or upside down.

Because of the findings of my second test I designed a crushing cylinder which would not allow the user to put the bottle in at a slant or on its side. The cylinder was made of 4" PVC pipe. I designed 4 compactors and in test three compared them for efficiency. Compactor 1 was 110 volts with a screw down plunger. Compactor 2 was 12 volts and used gears for crushing. Compactor 3 was a 2 ton hydraulic jack. Compactor 4 was a hydraulic Electro-lift from a snowplow. Compactor 4 proved to be the most efficient.

# OPTICAL SCANNER

Hall, William D., Comstock High School, Comstock, MI 49041;
2532 Rusridge Ave., Kalamazoo, MI 49007

The purpose of this project is to build an optical scanner that can be used to load images into the computer from paper. To build the scanner, the general theory of its operation was worked out, and circuit diagrams were drawn up. The circuits were tested and modified on a breadboard, then were soldered together on perforation-board. After the circuits were made to work, cardboard models of the physical part of the scanner were tested, and a final model was built of wood.

The final version of the scanner works as it had been planned to work with one exception; the photocells vary in resistance more than was hoped. This variation was compensated for by adjusting the resistance of the resistors in series with the deviating photocells, but the adjustment could not be made very accurately. Consequently, the only useful part of the sensitivity control is the manual adjustment, and detecting different shades of grey is impractical.

The scanner works flawlessly reading black lines on white paper. Since the greatest usefulness of a scanner is in its ability to read text, this level of performance is adequate. More accurate light-level detection and higher resolution could be achieved by using an image-digitizing integrated circuit instead of photocells.

There is much manual computer entry in the world that could readily be automated with scanners similar in principle to this one. Tests could be graded, mail sorted, checks cashed, factory orders taken, and printed material modified with specialised versions of this scanner.

\#Third Award - Junior Engineering Technical Society
Fourth Award - General Motors ISEF

RADIATION ENVIRONMENT ON INTEGRATED CIRCUITS UNDER BIAS

Francis, Geoffrey S., Marshalltown H.S., Marshalltown, IA 50158
R.R. 1, Box 263, Marshalltown, IA 50158

The purpose of this study is to evaluate the effects of X-ray radiation on integrated circuits. This research is a result of a three-year study. During the first two years, a basic study was done to develop a technique and understanding of the effects caused by X-rays, because no background data was available. RAM and EPROM memory integrated circuits were exposed to levels of radiation between 0.01 and 1000 Rads. Little damage was found at these levels. In the third year, these devices were exposed while under simulated operating conditions (under bias) at the same levels of X-ray radiation as a comparison. After looking at test results, the researcher noted significant damage and many unusual phenomena. During testing, 64K and 128K EPROMs were exposed to the aforementioned levels of radiation by using an industrial X-ray defraction system. Over 502 million data points were collected and analyzed. The resulting damage included modification of the lattice structure which caused a tunnelling effect. It was observed that the microchips were frequency sensitive. The results show that it is now possible to understand the amounts of shielding and other actions necessary to guard against damage when integrated circuits are exposed to X-rays under many realistic conditions.

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* THE ROBOTIC ARM

Newcity, Marshall J., Greenwood H.S., Greenwood, AR. 72936;
Rt. 2 Box 328-R, Fort Smith, Arkansas 72916

My purpose of building a robotic arm was mainly to see if I could. My main goal the second year was to control the arm by using gear boxes. This goal was achieved so I believe the project was a success.

I began my project by drawing out all of my designs. Next, I bought all of the materials necessary to build the project. I then went to work. I used the designs to see what I needed to cut out of the sheet aluminum and the wood. I used shears to cut the sheet aluminum and I used a hand saw to cut the wood. After this, I bent everthing into shape with plyers and a vice. A drill press and a hand drill were used to drill holes in all of the materials. I then used wood screws, nuts and screws to put everything together. The second to the last step was running fishing line around the wrist, to the arm, and through the fingers. After that I tied the joints of the fingers together with rubber bands. The final step was wiring the gear boxes to the switchboard.

The result of my project was an arm, run by gear boxes, which could turn, go up and down, open and close the fingers, and go left and right.

I conclude that my project was a success because I accomplished a project which required me to create a robotic arm.

I believe I will be able to apply my knowledge of robotics in choosing a business career.

*Honorable Mention - National Aeronautics and Space Administration

The DC-1 ELECTRONIC ALARM SYSTEM

Carter, Daisy C., Woodrow Wilson H.S., Wash., DC 20016
1315 Holbrook St., N.E. #3, Washington, DC 20002

Safety in the communities is just as invisible as a needle in a haystack and the need for countermeasures against thieves sticks out like a sore thumb. With this concern in perspective, the purpose of designing the DC-1 Electronic Alarm System is to sustain an efficient, fool-proof means of home security. It was designed with two aspects; (1) the connection of windows and doors to the alarm and (2) a mild shock produced on the door knobs when the system is set and entry is attempted through a door. The supportive objective of the system is for it to remain on, once activated, until proper deactivation occurs.

The procedure used to construct the system involved using metallic strips, wires, and relays as sensors for the alarm. I used a DC power supply, which is connected to the relays, in order to supply power to the system. A microswitch was used as a sensor for the shock that is produced on the door knobs. The microswitch is connected to a battery holder, a transformer, and the door knobs. This connection provides input and output power for the shock on the door knobs.

The DC-1 Electronic Alarm System has a regulation system represented by a key and a keyswitch. Within the walls of a home, the regulation system is the only way to control the activation and deactivation of the alarm system. Through experimentation, the system has proven itself to be efficient and fool-proof.

# LIPREADING ASSISTANCE VIA FOURIER ANALYSIS

Hunckler, Laura A., Central Catholic High School, Lafayette, IN 47905
2323 Ellen Drive, Lafayette, IN 47905

Hearing and understanding are two necessary skills to cope in today's society. The hearing impaired must resort to other senses besides hearing in order to comprehend speech. One common technique used is lipreading. Lipreading, however, only provides 1/3 of the information needed to sufficiently recognize speech. The syllables mah, pah, and bah, for example, have identical visual information. Additional information is needed to accurately distinguish between these sounds.

Normal hearing analyzes sounds heard and distinguishes the frequency content of words. In other words, the Fourier transforms of the time varying acoustic pressure are different. As one speaks, there is a series of different transforms, or a frequency spectrum that produces speech intelligence. This time varying frequency spectrum can be achieved in a number of ways.

In this project I chose to achieve a changing amplitude varying frequency graph by passing an audio signal through a parallel set of ten bandpass filters. The output is then displayed with a 10 x 10 display of LED (light emitting diode) lights.

After altering and building the circuit I then tested the percentage of speech intelligence achieved through the hearing prosthesis in a minimal time training period.

The present voice analyzer is a new variation of a previous idea of aiding the deaf. This new device provides advantages in that not only can speech be recognized, but so can other noises such as horns, bells, wind, etc. due to the fact that all sounds contain a frequency spectrum. Also, this device requires minimal training of the deaf and no training of the speaker.

#First Award - Sigma Xi, the Scientific Research Society
Second Award - Acoustical Society of America
Third Award - Institute of Electrical and Electronics Engineers, Inc.
Fourth Award - General Motors ISEF
Honorable Mention - American Speech-Language-Hearing Association

#HOW CAN ROCKETRY STAGING BE IMPROVED? PHASE II

Rider, Todd H., Ole Main H.S., North Little Rock, AR 72114
501 West A St., North Little Rock, AR 72116

CIGAR (Continual Improvement for Greater Advantage in Rocketry) is an entirely original scheme for improving staging in liquid and solid propellant rockets. For liquid systems, a central fuel tank spans the length of the vehicle and is surrounded by doughnut-shaped oxidizer tanks. The rocket motors are mounted on a sliding carriage which seals the lower end of the fuel chamber; as the fuel is consumed, the engines rise due to their own thrust, allowing the doughnut stages to be jettisoned once they fall below the motors. The solid propellant design employs conventional solid propellant in its uncured gel state. This gel is fed into a sliding, liquid monopropellant engine, and once again ring-shaped stages are dropped as the motor rises. Potential design problems are solved with current, proven technology.

To test these concepts, computer flight simulations, wind tunnel tests, and working models were used. Using detailed specifications of the Pershing IA, Titan 34B/NUS, and Delta 3914, estimated specifications of their CIGAR counterparts were developed and included generous weight penalties. In highly accurate simulations designed for and run on a Texas Instruments 99/4A computer, the improved vehicles exhibited 20-50% improvements in range, payload capability, and necessary vehicle size. Scratch-built models tested in a home-made wind tunnel demonstrated that the proposed designs are as stable as their competitors. A working model is now being constructed and tested.

This project is the second year of a two-year study, adding greatly improved simulations, new design concepts, the wind tunnel tests, and the working model to the previous year's work. Applications, further advantages, limitations, and future research are discussed.

#First Award - General Motors Corporation
First Award - General Motors ISEF
$3,000 Scholarship - Rockwell International
First Award - United States Army
First Award - United States Navy/Office of Naval Research
Second Award - United States Air Force
Alternate to LIYSF Trip - United States Navy/Office of Naval Research
Honorable Mention - National Aeronautics and Space Administration
Glenn T. Seaborg Nobel Prize Visit Award

Solar Engineering

James Wu
Bartlesville High School
1054 Meadow Dr. Bartlesville Ok. 74006

Purpose: To gain optimum solar potential and computer control with innovative house design

Research: Mechanically designed a roof, and panels that would follow the sun with the help of the computer

Conclusion: Greater efficiency can be reached with special roof design and computer assistance.

EXPERIMENTAL ROBOTIC INTERFACE ENGINEERING

Rogers, William D., Jackson H.S., Jackson, MN 56143
700 Park Street, Jackson, MN 56143

This is an engineering project involving the construction and design of a mobile base, an on-board microprocessor, power switching module, and an interface for operation by an external computer. The purpose of the project is to serve as an experimental laboratory for the study of computer interfacing, sensors, and artificial intelligence.

An on-board microprocessor contains a random number generator, 1 kilobyte of RAM memory, input/output ports, and a binary programming panel.

The relay unit was designed to step up the current from computer signals by transistor amplification to the current required to operate the relays. These in turn switch the high currents required by the motors.

The computer interface was built to over come the time consuming programming required by the on-board computer and to extend the range of experimention possible.

Experiments include response to contact sensors and an optical tracking device. Programs developed allow manual and program control and control by interaction with sensors.

Future expansion of the project will involve a serial data link with an external device. Further experimentation will include a study of guidance systems and artificial intelligence programs.

GROWTH OF SACCAROMYCES CEREVISIAE ON HYDROCARBONS: FOOD FOR HUNGRY COUNTRIES —

Burrows, Christine M., Villa Walsh Academy, Morristown, NJ 07960
17 Holly Dr., Denville, NJ 07834

The synthesis of protein from petroleum involves the growth of microorganisms on various petroleum substrates and the harvest of dried microbial cells as a product. Many species of both yeast and bacteria are applicable and, therefore, the product is referred to as "single-cell protein." Production of cells is particularly suited for continuous operation. One major obstacle has been the separation of the product from the petroleum or hydrocarbon. In this work, I have developed a novel technique for growing yeast protein in the *vapor* above the liquid in a storage container. This method, of growing yeast above the petroleum, eliminates the expensive and difficult step of harvesting the cells from the medium. The separation then becomes a trivially simple (and therefore cheap) procedure. A test of the procedure yielded 33.5 g of yeast in a 24 h growth period. In a test of solution growth under comparable conditions, separation difficulties prevented a completely quantitative determination of the amount produced, but it was approximately 20 g. Therefore, not only was the separation far easier using the vapor growth technique, but the rate of production was increased some 50%.

TOTALLY EFFICIENT SOLAR UTILIZATION

Fields, Christopher Blake, Navajo H.S., Altus, OK 73521;
612 Vine Street, Altus, OK 73521.

The objective of my project is to construct a hot water heating system that utilizes the free energy of the sun to heat and pump the collector fluids without electric controls or sensors and protects itself against freezing and stagnation. The pumping action is created by a combination thermosiphoning and solution phase-change. The system should be self-generating and self-regulating with little or no maintenance required.

The objective is accomplished by building a closed-loop flat-plate solar collector system utilizing a non-toxic alcohol/water solution (80-20 ratio). The solution's freezing temperature is below expected night-time low temperatures and boils off into a vapor form at easily achievable daytime collector temperatures to create sufficient system pressure to pump the water. The system is built using readily available materials at an approximate cost of $8.00 per square foot.

The collector area can be sized to fit the desired output. As a preheater to an existing system, it would optimally provide 60% of the required hot water. By increasing the collector area and tank storage capacity, one could provide 90 to 100% of the required hot water.

Testing thus far indicates that this system has definite possibilities as a supplement to traditional central heating simply by adding a water heating coil in the supply air duct. I plan to pursue this aspect in my future research and to experiment with varied solutions to achieve high transfer rates and with different piping arrangements to increase efficiency.

My research to this point has proved the economic and physical feasibility of this system. It's utter simplicity provides low maintenance and high efficiency.

OBSERVATIONS AND MEASURMENTS OF DRAG AND FLUID FLOW AROUND SUBMEREGED BODIES

LEE, SCOTT YONG, ROY H.S., ROY, UT 84067;
5138 So. 1950 W. ROY, UT 84067

The drag produced by a submersible is easily removed by using a very smooth surface, however a very smooth surface is easily detected by sonar. The purpose of this project is to design a surface texture or line pattern which would deflect sonar and have a drag comparable to a smooth surfaced submersible.

Ten design models were built and tested, each design being tested six times for drag, fluid flow and stability of the submersible. All the tests were conducted using an appuratus which I designed. The appuratus was constructed of 8 inch P.V.C. pipe in a circular arrangement. The water was pumped in a circular route as to create a steady flow. This steady flow was needed for accurate measurments of drag on the submersible. Observations of fluid flow around the submersilbe were made with the aid of a dye tracer emitted for the bow. The observations were made through a viewing port installed on the appuratus. A mercury nanometer was used to monitor the pressure during the experiments.

The results of the experiments show the submersible with a plastic skin, a very smooth surface to have the smallest drag. However comparable results were obtained using a sub with a line pattern, grooves parallel to the flow. One of the most interesting results from the experiments was found in the affects that size of grooves has on the drag and flow. Grooves with the correct ratio of diameter to the size of the submersible greatly enhanced stablity as well as decreased drag. This size of groove would also decrease sonar detection.

*MPRO 16: HARNESSING 16-BIT MULTIPROCESSOR TECHNOLOGY

Ouellette, Edward J., Carman High School, Flint, Michigan, 48504; 5121 Briar Crest, Flint, Michigan, 48504.

The problem I addressed was to design, construct and program an inexpensive portable microcomputer which runs on low power without sacrificing performance. My goal was to create one of the first 2 watt 16-bit systems compatible with Commodore disk drives and printers. An ad for an improved 8086 microprocessor prompted my research. Not only is the 8086 one of the most powerful and popular industrial microprocessors, but it is also one of the least expensive. After 400 hours in design, I was prepared to document my circuit. I spent over 200 hours drawing the schematics and port designations, and 1 month prototyping. Thanks to the courteous faculty at GMI - Engineering & Management Institute, I was able to fashion a simple modular operating system with the Intel Series IV development stations. My project is lightweight, costs less than $700, it's portable and it can outperform the IBM PC in speed tests by over 200%. Other features include 16-bit multiprocessor and coprocessor support, battery failure predetection, voice input port for speech recognition, 64K of memory expandable to 1 megabyte, 2 parallel ports, 1 year battery backup for the RAM, a security keylock to prevent unauthorized use, a built-in audio amplifier with an external mixing input and an interchangeable keyboard and alarm switch matrix. In conclusion, my computer is well suited for military, industrial, and personal applications.

*First Award - American Committee for the Weizmann Institute of Science
First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - IEEE Computer Society
First Award - Institute of Electrical and Electronics Engineers, Inc.
Grand Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society
$2,000 Scholarship - Rockwell International

COMPARISON BETWEEN NORMAL CONCRETE WITH CONCRETE USING CRUSHED GLASS INSTEAD OF SAND AS FINE AGGREGATE

Ortiz, Marcos, José De Diego High School, Mayaguez, PR 00709; Barrio Manantiales, Mayaguez, PR 00709.

A mixture of concrete was prepared using crushed glass as fine aggregate in a design of a mix of 3,000 pounds of compression. Six cylinders were used, following the standards set by the A.S.T.M. for the compression test and several cubes of 8 cubic inches for the mortar cement.

Two model houses were also constructed. Each one eight cubic feet in size. One was made using normal concrete and the other using crushed glass as fine aggregate to compare energy conservation in both cases.

Data collected indicates that it is possible to substitute sand with crushed glass as fine aggregate in the manufacture of concrete since the results obtained are acceptable to the A.S.T.M.

* INNOVATIVE CAM ENGINE DESIGN AND TESTING

White, Jody, Melbourne H.S., Melbourne, FL 32901
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The purpose of this research is to develop an improved high-efficiency, high-torque reciprocating piston engine as an alternative to the conventional crankshaft design. The engine consists mainly of a cycloidal cam with a piston and connecting rod roller follower. A supporting member is used to minimize side forces against the piston. Cams are advantageous because the piston rise and dwell periods can be controlled to optimize engine torque and to allow a longer combustion period. This potentially enables more complete combustion and improved fuel economy.

During the first phase of this experiment, variations of engine cycles were evaluated and the operating theory of the engine was developed. The effects of several exhaust recovery systems on the thermal efficiency and work output were examined. Major efficiency gains of 25-45% can theoretically be attained with a unique reheat cycle scheme devised for the cam. Due to the cam profile, combustion is always constant volume. Thus, a compression ignition cycle with a high compression ratio may be combined with constant volume combustion, allowing greater thermal efficiency than the Diesel cycle.

In the second phase of this experiment, a working prototype cam engine was designed and tested to demonstrate that the cam concept works. A 7-hp Briggs and Stratton engine with an AG-Tronic power generator was modified for cam operation. The experimental engine operated on a four-stroke spark-ignition cycle.

The working model shows the potential for developing a full-scale engine. Future research goals are to test a full-scale cam engine with incorporation of reheat.

#First Award - General Motors Corporation
First Award - Society of Women Engineers
London International Youth Science Fortnight - United States Army
First Award - United States Department of Energy
Second Award - General Motors ISEF

APPLICATION OF THE MECHANICS OF MOVEMENT IN THE CONSTRUCTION OF AN INSTRUMENT FOR THE PHYSICALLY HANDICAPPED

Pérez, Gilbert, Blanca Malaret H.S., Sabana Grande, PR 00747;
Urb. Villa Interamericana, Calle 4 C-28, San Germán, PR 00753.

In the last few years the field of mechanics has been used by human beings for their benefit, specially in individuals with certain physical handicaps. Through this work I attempt to show how the application of mechanical engineering and the mechanics of movements help us in the construction of a machine that is useful for handicapped people. This work also stimulates people giving them greater resources to create more efficient machines with more movements that will help to make the work to be realized easier.

In the construction of this project, the following materials were used: plastic tubes (7), antenna rotors (4), car antenna motor (1), tripod (1), 3/8" pannel, converter (1) and one car battery.

The motors permit a movement of 360°. The clamp of the project moves with the aid of a motor of a car antenna. The converter gives electricity to the machine without having to connect it to a current receptacle.

The machine has the capacity of lifting two pounds, it lifts this weight at a height of 4 feet and takes it a distance of 3 feet. It can also seize objects with a cubic volume of 2.5"^{3}.

#MICROCOMPUTER ACTIVATED ROBOT ARM (MARV)

Herrmann, Steven L. Mahtomedi H.S., Mahtomedi, MN 55115
648 Florence Avenue, Mahtomedi, MN 55115

This is the third year of an ongoing project on robotics. Each year the purpose has been to delve more indepth in to the practical applications of robotics. The first year simply skimmed the surface of robotics. An R2D2 type device was designed and built for the purpose of becoming acquainted with the different mechanical and electrical properties involved in robotics.

The second year involved much more practical research in to the area of factory robotics. This lead to the construction of a simulated factory robotic arm. This robot had five degrees of freedom and was able to move through preprogrammed sequnces under computer control.

The current year's project has focused on artificial vision for robotics. The purpose was to create a vision system that could be utilized by a robot for part recognition. To accomplish this the robot from the previous year was redesigned, rebuilt and new software developed. The redesign was done in an effort to make the robot more precise and enable it to be interfaced with a vision system. The vision system that was created utilized a video camera to transmit a picture of the work area directly in front of the robot. The computer would then scan all the objects on the work surface and take this information and use it to manipulate the objects as the user saw fit.

The expection of the project was met, that is to pick and place randomly placed objects through the use of a vision system. The most significant problem encountered was obtaining enough accuracy in positioning the arm with five degrees of freedom.

#Second Award - General Motors ISEF
Second Award - Institute of Electrical and Electronics Engineers, Inc.
Second Award - Society of Manufacturing Engineers
Honorable Mention - National Aeronautics and Space Administration

#AN INTELLIGENT LOW COST EPROM PROGRAMMING SYSTEM

Cooke, Larry B., Merritt Island H.S., Merritt Isl, FL 32953
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The growing computer industry has caused an increased need for system development devices such as EPROM programmers. An EPROM programmer is used in the software development stage of computer design by transferring program code from a computer's memory on to a chip called an EPROM. This EPROM is then placed into the system hardware to test the program. EPROM programmers are a must in computer design however they are often extremely expensive. The purpose of this project is to design and build a powerful EPROM programming system at a very low cost which performs better than these more expensive units. The unit is microprocessor controlled and interfaces to a computer via a serial communications port. It has an extensive command set allowing the user many options in the process of programming an EPROM. A variety of chip types from several different manufacturers can be selected from a menu list. The many features and low cost of this project make it a powerful alternative to the high cost EPROM programmers of today's computer development market.

#Third Award - General Motors ISEF

#TESTING LIGHTWEIGHT MATERIALS AND STRUCTURES

Hall, Richard N., Athens H.S., Athens, Al 35611
604 Box Street, Athens, Al 35611

This project was devoted to developing a test procedure and the necessary test equipment to provide data on the elasticity, and the temperature and humidity sensitivity of covering materials as used on contest model airplanes.

A measurement of the sag of a sample of the material attached to a test frame was determined to be the best method to provide the data. A special oven/humidity chamber was designed and built for the project. A depth micrometer was used to measure the material sag.

Seven covering and finishing material combinations were selected to be tested. Four test weights were used, and each sample was tested at three temperature and three relative humidity levels. This provided a matrix of 252 tests. After the tests, the samples were cut from the test frames and weighed on a specially developed scale. All data was converted to the metric system..

When the results were plotted on graphs, they demonstrated that the system was capable of providing accurate results. This was evidenced by the good linearity exhibited by many of the graphs. Each graph provided elasticity comparison of the test samples at the same temperature and humidity conditions from teh slope of the curve. The change in slope of the curves for the same material from one temperature graph to another at the same humidity level provided an indication of temperature sensitivity, and vice versa for humidity sensitivity.

#First Award - United States Air Force
Third Award - General Motors ISEF

WINGLESS AIRCRAFT

Johnson, Tony, Weber High School, Pleasant View, UT 84404
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Is it possible to design and build a wingless aircraft? I thought it was possible and set out to prove it. My ways was to combine two ideas that have already been proven to be true. The first idea is Bernoullis Law. This law states tha in any stream flowing without friction the total energy contained in a given mass is the same at every point in its path of flow. The flight of an airplane is based on the principle of Bernoullis Law.

The distance fromthe leading edge to the trailing edge of a wing of an airplane is greater on its upper curved surface than on its lower surface.

As a result, air flowing over the wing has a higher velocity than air flowing under the wing. The difference in pressure accounts for the lift of an airplane.

The second idea is the one of an air cushion vehicle(ACV). An (ACV) is a vehicle that rides on a cushion of air. The ACV is maintained by a downward flow of air around the periphery of the vehicle. The clearance obtained is two or three times more than the thickness.

An ACV can operate with the skirt very close to the surface over which it is traveling. By combining the two ideas, I have designed and built a aircraft that will not only go over land and water , but will also fly like an airplane.

Flexible substances such as rubber-containing nylon makes the skirts so that the clearance needed will require less power to work the aircraft.

A COMPUTER INTERFACED DEVICE FOR THE DIGITIZATION OF LASER INTERFEROGRAMS

Hamilton, Scott M., Shiloh Christian School, Springdale, AR 72764;
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Laser interferometry is an optical method of very precise measurement. The laser interferometer produces a pattern of light and dark fringes which can be interpreted in order to analyze certain characteristics of the object being tested. The purpose of this project was to design and construct a device that would interface with a computer to automatically scan and digitize laser interferograms.

A mechanism was constructed that would scan the interference pattern in seperate rows, starting at the top of the pattern and scanning downward. This device consisted of a phototransistor mounted on a slide unit which allowed movement along a vertical and horizontal axis. The phototransistor was moved along these axes by two independent stepper motors. The photosensor and motors were interfaced with a computer to allow the computer to control the movement of the photosensor and to monitor the amount of light received by the phototransistor. A computer program was written to control the motors, monitor the photosensor, and store the data. The program also recalled the stored data and graphically reproduced it on either a monitor screen or a printer.

The device worked very well and performed all of the digitizing functions automatically with little human input. The apparatus was tested on actual interference patterns with good results. This device shows many useful applications which include the evaluation of microsurfaces in the optics industry and structural stress measurements for use in non-destructive testing.

A ROBOT OF A DIFFERENT COLOR

Hawk, Bryan, MacArthur High School, Lawton, Ok. 73501.
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The purpose of this experiment was to convert a manual spectrometer to an automated system using two Sigma stepper motors and a Commodore 64 computer.

A circuit board was constructed that allowed the computer to control the number of steps and the direction of the turns of the stepper motors. Another circuit board was used to read the voltage going to the meter on the spectrometer. A program was then written to read the voltage going to the meter on the spectrometer and move the two stepper motors accordingly. This was to move the stepper motor that adjusts the light intensity until there was a reading of 100% transmittance from the meter on the spectrometer while counting the number of steps it took the stepper motor to adjust it to that particular point. Then it was to change the wavelength and repeat this process forty-seven times. The water sample is then replaced with a chemical sample. It was not adjusted to 100% transmittance, instead it moved the stepper motor the same number of steps as it did with the water at that particular wavelength. The readings of the light intensity at a particular wavelength were plotted on the computer screen.

A manual spectrometer was converted to an automated system using two Sigma stepper motors and a Commodore 64 computer with little or no modification to the original instrument.

SEEING THE INVISIBLE-A STUDY IN RADIANT HEAT

Alexeff, Alexander, Oak Ridge H.S., Oak Ridge, Tn., 37830
2790 Turnpike, Oak Ridge, Tn., 37830

Long wave-length infra-red radiation emitted from very hot objects, very cold objects, and even objects that are very near room temperature can now be observed by the use of a very simple yet effective device. The radiation is imaged by a parabolic, front-surface mirror of very large solid angle on a sheet of liquid crystal. A large solid angle mirror is required to collect enough radiation to overcome the thermal background in the room. The liquid crystal sheet changes color as a function of temperature, and provides a visible image of the thermally-emitting object. An image of the human hand emitting in a room at room temperature has been obtained. To increase the sensitivity of the device, a much more sensitive liquid crystal sheet has been obtained. This sheet has a much narrower but higher temperature range than the sheets previously used, and so requires an additional heat source to warm it to its most sensitive range. An advantage of this new crystal is that the images projected upon it are not subject to as much blurring by the constantly present fluctuations in room temperature. In other words, the flood light that is used to sensitise the crystal now regulates the surrounding air temperature, instead of having the crystal be at the mercy of any changes in room temperature. This simple imaging device should be very useful in detecting heat leaks from objects, as well as in studying the infra-red emission or transmission of various materials. An infra-red floodlight increases the sensitivity and speed of the response of the device for medical, technical, or survellance purposes.

#USING THE "SWIRL EFFECT" TO ENHANCE THE ENERGY PRODUCTION OF A WINDMILL

Eames, Aaron J., Roy Jr. High, Roy, UT 84067
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After air passes through a windmill blade, the air continues "swirling" or spinning in the same direction the windmill is rotating. This spinning of air caused by the turning blade is called the "Swirl Effect."

By designing a windmill with a counter-rotating blade placed behind the primary blade, I hoped to use this swirling air to increase the energy production of the windmill. Using fan produced wind, the power of a model double-blade windmill system and a model single blade windmill system were tested. The power of the double-blade windmill, measured in gram centimeters per second, was 40.1% more energy productive in a 3.5 mph wind and 34.3% more productive in a 5.5 mph wind than two single-blade windmill systems. The double-blade windmill system proved to be more effective in lower velocity winds, making it applicable to most areas of the United States.

The increased need of new energy resources in the United States makes this project viable as a more efficient, renewable energy resource.

#First Award - United States Department of Energy
Honorable Mention - Bureau of Reclamation/U.S. Department of the Interior

FLYING INTO THE FUTURE- DESIGNING THE NEXT GENERATION JET TRAINER

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The Next Generation Jet Trainer Aircraft must excel in flight training performance. Avionics will dominate the pilot's attention. The aircraft must be aggressive and forgiving, allowing the new pilot to learn quickly without restraint. The designer's attention was focused upon the aerodynamic design of the aircraft. An all-lifting fuselage requiring minimum wing area was developed. This increased the aircraft's lift-to-drag ratio by a factor of 8.65. Wing area was reduced by 13.45%. With reduced wingspan and structural loads, the aircraft's maneuverability was greatly enhanced. The primary emphasis of the design was based on a canard configuration, providing positive pitch. The canard enables the aircraft to utilize short runways and provides the student pilot with valuable canard flying experience. An externally mounted propulsion system incorporated into the aircraft design will provide ample air supply, even during abnormal flight situations common during pilot training. Two Garrett F-109 high-bypass ratio turbofan engines rated at 1,330 pounds of thrust each will be housed in the aircrafts propulsion pod. Pilot visibility is unsurpassed. Both the student and the instructor have unobstructed visibility of their surroundings. The dreaded flat spin has been tamed by repositioning the majority of the aircraft's mass as close to the center of gravity as functionally possible. The addition of compressed air jets at the wintips will cancel any spinning forces. The result is a jety trainer which allows the student to learn quickly in a comfortable environment.

#First Award - International Aerospace Hall of Fame
Third Award - General Motors ISEF

# SPEECH SYNTHESIS AND RECOGNITION

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The objective of this project is to develop a special communication link between the human and a computer. This communication link will allow the computer to synthesize and recognize the human voice. The system was planned to be able to synthesize and recognize any word in the English language.

The first year was devoted to analyzing the human voice and developing ideas on linking the voice to the computer. The computer, Speech Synthesis Interface, and the text to speech algorithm were developed and implemented. Even though the quality of speech reproduction did not prove to be satisfactory, the Modified Naval Research Laboratory Letter to Speech Algorithm performed well.

The second year was devoted to improving the quality of the Speech Synthesis System and developing the Speech Recognition System. The Speech Recognition Interface, the end-point recognition algorithm, the amplitude normalization algorithm , the time normalization algorithm and dynamic time warping algorithm were developed and implemented. Even though this phase is not completely operational to its fullest extent, it exhibits a lot of potential.

I have concluded that this project has enormous potential for the future even though it has not been carried to its completion. The communication link can be utilized to help handicapped people perform daily activities by using voice commands, in security system, to input data in computer systems, and many other applications. Although I planned this as a two-year project, I have determined that two years was not enough time to fully develop everything. I could probably spend a lifetime and still not achieve perfection.

#First Award - General Motors Corporation
Honorable Mention - Acoustical Society of America

INFRARED AUDIO TRANSMISSION: GUIDED AND UNGUIDED CIRCUIT DEVELOPMENT AND CONSTRUCTION

Scott, Ted R., Raleigh Egypt H.S., Memphis, TN 38128
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The objective of this research and experimentation was to design, build, and to test circuits for transmitting and receiving audio by means of infrared light through two known optical media -- "guided" (through an optic fiber) and "unguided" (across a void.) The circuit was first designed for an infrared unguided system and then modified for the infrared guided system.

After careful research and sketching of circuit layouts, acid Etching was employed to construct from the notes printed circuit boards suitable for application and use. In using these "home-made" printed circuit boards, it was possible to construct practical and inexpensive working prototypes which were subsequently tested, modified, and refined. The results show that the audio reproduction was much cleaner in the guided system because it did not have to contend with the atmospheric interference that the unguided system did.

In conclusion a simple working model has been constructed at relatively low cost which can lead to the development of more refined (and more expensive) systems. It is the hope of this student that the project defined herein will provide a practical and substantial means of guided and unguided infrared tele-communications.

COIL GUN MAGNETIC ACCELERATOR

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Recently the scientific and military communities have become involved in the Strategic Defense Initiative. One component of this defense plan is the coil gun magnetic accelerator. A coil gun can fire a projectile at tremendous speeds with low input power. Unlike conventional weaponry, a coil gun accelerates a projectile by the use of induced magnetic fields. Because of the experimentor's past research on magnetic properties and interest in SDI, it was the purpose of this project to design and construct a working coil gun magnetic accelerator that would fire a significantly sized projectile at a minimum velocity of 40-50 meters per second.

It was determined that for the accelerator to have a high output velocity and low input power, large capacitors would have to be used to supply the magnetic coils with current. After obtaining the capacitors and building the power supply, several different coils were constructed and tested. The wire gauge, length of coil, and number of wraps were optimized to supply the highest acceleration and allow practical construction. Spacing and timing of the coils could not be reliably calculated due to uncontrollable variances in the launch speed. Therefore, optical triggers were used to fire each stage, making the acceleration system self-correcting. The trigger system was designed, constructed, and interfaced with the coils. As stages of coils were added, the placement of each coil was optimized. An optoelectronic timer was developed to allow measurement of high velocities. Five coil stages yielded a projectile velocity of 28.68 meters per second.

#First Award - BDM Corporation
Third Award - General Motors ISEF

# INFLUENCE OF METALLURGICAL STRUCTURE ON THE CORROSION RESISTANCE OF ALITHALITE

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2131 Vine St., Davenport, IA 52804

The purpose of this experiment was to explore the difference between the corrosion rates of recrystallized and unrecrystalized forms of Alithalite 2090 alloy. In conducting the experiment, ten one inch square samples of each form of the alloy were cut. The samples were then eighed and five of each were put into the EXCO solution and the same amounts were put into a one molar NaCl solution. The samples were left in the solution for a period of one week then were removed and were measured for weight loss. The experiment was conducted for a period of four weeks. After the four weeks the samles were taken to the metallurgical lab at Alcoa Davenport Works where they were observed at 6X magnification initially. Then a few selected ones were mounted and polished for observation under higher magnification and in a Scanning Electron Microscope. The results from the weight loss were very interesting as they didn't quite turn out as it looked. The recrystallized sample in the EXCO solution showed a much more extensive exfoliation attach while the unrecrystallized sample showed the most weight loss by percentage. But the unrecrystallized form showed much more surface pitting. In the one molar salt solution the recrystallized sample had more weight loss by one tenth of a percent. The unrecrystallized forms also were first to show signs of any exfoliation. This is probably due to the fact that the unrecrystallized structure has a much more defined layer structure and is less vulnerable to surface attack than the recrystallized structure. It was also evident that most of the exfoliation attack came from the sheared surface. The larger pieces would be less affected by this kind of corrosion as a lot less percentage of the total surface area would be sheared surfaces.

#First Award - Eastman Kodak Company

# PIEZOELECTRIC FILM AS A TRANSDUCER

Ryder, Scott W., Edison/Computech H. S., Fresno, CA 93721
5517 E. Butler, Fresno, CA 93706

Piezoelectric film is manufactured from a thin sheet of polyvinylidene fluoride, vaporplated with either aluminum, nickel or silver. The piezoelectric character is created by a poling process by which the heated film is cooled under a high electric field. The film then generates a voltage when its dimension is changed, or it changes its dimension when a voltage is applied. In this study, piezoelectric film was glued to a cantilevered metal bar and acted as a strain gauge. The free end of the bar was driven with a speaker over a frequency range of 10hz to 400hz. The displacement of the bar was measured by an optical lever using a laser reflected by a mirror glued to the bar and detected by a phototransistor. A computer was used to digitize and simultaneously collect the output of the film and phototransistor. It also calculated strain and plotted the results. The dynamic measurement of the bar displacement was necessary because the film would not yield static strain measurements. The data showed a linear relationship between film output and strain; however, the output varied as the driving force frequency changed.

#Third Award - General Motors ISEF

#TOWARD A TOTALLY NON-TURBULENT AIRFOIL

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5800 Woodland Court, Farmington, NM 87401

The intent of this project was to determine if the injection of air into the boundary layer flowing over the rear half of an airfoil would reduce turbulence. The hypothesis established was that compared to the surface of a conventional airfoil, slots along the rear half of a modified airfoil would increase the presence of laminar airflow, thus reducing turbulence.

An opening in the leading edge supplied the air which was forced out the slots along the upper surface of the airfoil. Four slots were opened along the rear half of the upper surface on the wing. A small, low speed wind tunnel was built for this project. The assumption was that any positive effects at low speed would be a factor at high speed. Three methods were used to test the hypothesis. Surface pressures were measured with a manometer. Photographs were taken of air flow. Lift was measured with a spring scale. All three methods compared the modified version with a conventional wing.

The air supplied through the leading edge was forced through the slots, maintaining a faster air flow and reducing turbulence. The data clearly indicate a more consistent laminar flow of air across the rear of the modified airfoil surface.

The hypothesis was accepted; the slots along the modified airfoil did reduce turbulence, increasing laminar flow, thus reducing drag and increasing lift.

#London International Youth Science Fortnight - United States Navy/Naval Air Systems Command

# THE EFFECTS OF AN AIRFOIL ON A "HOT SHOT"

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RT 45, Eldorado, IL, 62930.

The purpose and occasion for the testing of a one-ton truck was an attempt to work toward a new development in these particular trucks. The technical name for these trucks is mini-flat beds, although they are called "hot shots".

The road use of the so-called "hot shot" trucks has been very recent. These trucks were first used for hauling LTL (less-than-a-load) freight. Because they are smaller in size and less expensive to operate than an 18-wheeler, they have virtually become "HOT SHOTS" in the transportation of bulk loads (insulation, plastic pipe, fiberglass, etc.).

My project consisted of two major types of testing. The first consisted of testing an actual one-ton truck with an airfoil. The second consisted of constructing a scale model and testing the model in a home-made smoke tunnel.

With these two methods of testing I have been able to determine how the airfoil helped/hindered the performance of the truck.

#Honorable Mention - National Aeronautics and Space Administration

RAILGUNS: Multi-Purpose Mass Accelerators

Davis, Conan L., Las Cruces High School, Las Cruces, NM 88001
5818 Lassiter Rd., Las Cruces, NM 88001

Electromagnetic mass acceleration is a method wherein the controlled interaction of electric and magnetic fields results in a useful production of directed kinetic energy.

Two prototype railguns were designed, fabricated, and tested. The first model built is a classic parallel rail system. The second model utilizes a coaxial rail design originated at Los Alamos Scientific Laboratory.

Both designs use a pulsed capacitor discharge to produce and accelerate a metallic plasma in a low pressure inert gas environment. Transit time and delivered energy through a one meter drift tube is measured by an electrometer and oscilloscope.

The low pressure inert gas atmosphere was chosen in lieu of a hard vacuum because of equipment restrictions. Despite the inert atmosphere, erosion of the electrodes is a potential source of failure.

Both designs are essentially analogs of series connected DC motors. The addition of external magnetic fields, either permanent or superconducting would enhance systems efficiency and should be investigated further. These accelerators though simple in concept are complex in execution.

As the need for economically viable energy conversion systems increases, the electromagnetic mass driver may find a valuable position in modern technology.

#Fourth Award- General Motors ISEF

THREE YEARS OF CONVERTING WASTES INTO PAPER PRODUCTS

Bernardo, Priscilla B., Branford High School, Branford, FL 32008
RT. 1, Box 11, Branford, FL 32008

The hypothesis of this project is Can a quality paper product be made from waste materials? The materials used to reach the conclusion were papers made from hay, cornstalks, newsprint, cardboard, sugarcane, sawdust, cotton waste, rye straw, computer paper, peanut hulls, and a commercially made paper. Three major procedures were involved in this project. The first procedure was the making of the papers. The second procedure was the seven tests given to each paper for: Flexibility, Memory, Absorption, Tensile Strength, Burst Strength, Flammability, and pH. Each paper was tested three times then an average score noted and graphs were made for clarity. The third procedure was the use the finished papers to make the products. It was demonstrated that products could be made from waste materials. It was also discovered that using the two methods of making paper in this project, coconut fibers could not be broken down into the needed pulp necessary for making paper.

# THE DESIGN AND CONSTRUCTION OF A LASER ENHANCED DATA ACQUISITION SYSTEM

Sant,David J., Catholic Central H.S.,Redford Mi.48239;
29587 Puritan, Livonia Mi. 48154.

The purpose of this project is to design and construct a more effective data acquisition system for use with robots.

After thoroughly researching the subject I discovered that taction or 3-D touch is one of the most important sensory inputs for robots. I found that the taction sensors used in industry today have many problems, some are: low resolution, high sensivity to electromagnetic interference, and a touch surface that wears out rather rapidly.

Keeping this in mind I began to design a complete data acquisition system. After months of careful planing I began to construct a prototype of this sensor.

The prototype sensor consists of a rectangular base with a 4X4 array of .960mm holes drilled 2.34mm apart, each hole contains one end of a fiber optic cable, the other end of this cable goes to a series of photo transistors. These photo transistors are connected to an interface circuit then to the computer. On one side of the surface,opposite the end where the fiber optics were inserted and perpendicular to the holes, lies a mounting block in which the ends of two fiber optic strands pass through. The opposite ends of these strands are connected to a red-neon laser. This system is mounted on the claw of a seven axis robot which I designed specifically for the sensor.

In conclusion I found that my sensor has great potential because of its stability and effectiveness.

#First Award - National Aeronautics and Space Administration
Fourth Award - General Motors ISEF

FLUFF: A STUDY OF COAGULATED AND SUSPENDED SEDIMENTS

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Fluff is a suspended, coagulated material that occurs in areas of the world where salt water intrudes upon fresh water carrying silt. Due to its suspension and limited coagulation, fluff can pose hazards to marine navigation. The objectives of the experiment proposed that a working model of a fluff environment can be developed, and the properties of fluff are separable for analysis. During experimentation, a controlled environment was successfully created to break down the properties of suspension and coagulation in simulated fluff and the two factors were viewed separately and as a whole to determine which combination of the two exerted the greatest force on a vessel moving downstream. Results indicated that coagulation is responsible for much of the force exerted on the tested vessel, although further experimentation is warranted by the limited scope of these tests.

#First Award - Marine Technology Society/U.S. Naval Institute

#GRAPHITE COMPOSITES: RESEARCH AND DEVELOPEMENT

Ehlis, John A., St. Mary's H.S., New England, N.D. 58647
Rt. 2, New England, N.D. 58647

Steel, one of the most commonly used materials where stiffness and durability are needed, has its' advantages but also many drawbacks. Graphite Composites, a revolutionary product, is just beginning to appear on the market.

My objectives were to make a new material, using graphite composites, that is stronger than steel and lighter than aluminum; to test graphite composites for strength and compare it to steel; and to test a combination of steel and graphite composites (glued together). Four tests were used; tensile strength, fatigue, prolonged stress, and torque.

An oil rig may be miles deep. A great amount of energy is needed to rotate it's heavy steel pipe and to pull it out. If lightweight graphite composites would be used to replace a portion of the steel drill stem pipe, it would need less energy to rotate it and pull out.

A cost analysis was conducted between graphite composites and steel to indicate if graphite composites would be an economical substitute. The cost analysis proved positive.

If graphite composites would be used to replace the drill stem pipe of an oil rig, a smaller rig could dig to greater depths.

#Second Award - American Society of Civil Engineers

CONCEPTS OF FLIGHT

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Lift is the force created by the wing airfoil to conquer gravity. How lift is produced is best explained by Bernoulli's principle of increased speed, decrease pressure. The top of the airfoil is curved and the bottom is flat. The air over the top of the airfoil must speed up to reestablish equilibrium at the trailing edge with the air over the bottom. Therefore, exerting less pressure on the top and creating lift. When angle of attack is increased the apparent curvature of the top of the airfoil is increased resulting in greater lift. Total drag is made up of the parasite drag and induced drag. Parasite drag is composed of form drag, skin friction drag, and interference drag. Parasite drag is increased with the increase of airspeed, it increases with the square of the increase of airspeed. Induced drag is the drag that results from lift, at the airfoil. When angle of attack is increased the vertices (that cause induced drag) are increased and therefore induced drag is greater at lower air speeds.

SMALL MICROCOMPUTERS IN REMOTE ENVIRONMENTS

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The engineering goal of this project was to design a microcomputer of the maximum power and versatility within the constraints of a specific application, storing data onboard a model rocket. The project used an array of four light sensors to demonstrate the computer.

The computer designed for this application successfully accomplished the goals set for it. Two recent microelectronics technologies allowed the total weight of the electronics and related structures to be reduced to 174.3g (6.15 oz.). A highly integrated CMOS (low power) microcontroller, the Intel 80C31, gave high speed processing power on a single integrated circuit (IC). The second technology, high density Electrically Erasable Programmable Read-Only Memory (EEPROM), allowed signifigant quantities of data to be nonvolatilely stored on a single IC. The entire rocket, including structure, propellent, and payload weighed 334.2g (11.8 oz.), well within the legal limit on the weight of model rockets, 454g (1 lb.).

In this application the computer functioned as follows: A sensing switch determined the time of liftoff, after which the four light sensors were sampled and the data saved at the frequency of 20 samples per second. After rocket recovery, the data memory IC was removed and read into an Apple computer. Simple analysis and display functions were then performed on the data.

The microcomputer was used as a data recorder in this case, and converting it into an active controller only requires software changes and the addition of mechanical servomechanisms. This design indicates the level of miniaturization achievable with present technology in solving relatively simple problems of data acquisition and control.

#INTENSIFYING A LASER USING A FIBER OPTIC CONE

RANKA, JINENDRA Roy C. Ketcham High School, Wappingers Falls, NY 12590
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Fiber optics is the study of the transmission of light along transparent fibers by containing the light by means of total internal reflection. My idea is to use this concept to intensify a lasser beam.

A fiber optic cone can fully contain the beam of light if each ray of the beam hits the cone at the critical angle. The refracted rays travel straight down parallel to the surface of the cone. Each ray of the beam will have a different path length so the outgoing beam will not be coherent. To solve this problem, the phase of each incoming ray must be proportionately adjusted before entering the cone. This can be done with a phase adjuster disc. The refractive index of the disc must gradually decrease from the center to the outer edges. The disc will delay the rays that have to travel a shorter distance so that all the rays will reach the virtual focus at the same time. The amount of time delay depends on the distance the ray must travel. The beam must also enter and exit perpendicular to the disc so that no bending occurs. An opaque center is also necessary to reduce interference in the outgoing beam.

The resulting beam will be intensified and hollow. It could be used from cutting holes to burning off the membrane of a cell.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society
Honorable Mention - Optical Society of America

#SMITTY II - THE ROBOTIC ARM

Smith, Mark, Highland H. S., Blackwood, NJ 08012
143 Victor Ave., Laurel Springs, NJ 08021

PURPOSE: The purpose was to develop a robotic arm that can simulate the movements of a human arm which a disabled person can't perform.

PROCEDURE: A control system was designed that utilizes mercury switches in a headband. (This design was improved upon from SMITTY I.) Research was done to become more familiar with robotic components and designs. The information was obtained from manufacturers of robotic components. A robot was designed that could be made from easy to obtain materials. (Designs were drawn and previous mistakes were revised.) Materials were obtained from a plastic company, hardware stores, and junkyards. When most of "SMITTY II" was completed, the headband was built with the circuitry to control the robot. The headband was then hooked up to the robot. The robot was tested. Five people were shown how to operate the robot only using their neck and jaw muscle as if they were disabled.

RESULTS: The robot simulates the movement of a human arm in response to the movements to the head and the jaw muscle.

CONCLUSION: A robotic arm was developed that simulates the movements of a human arm that a disabled person is not able to perform.

APPLICATION: This system could be used by paralyzed people in almost all situations. This system could be adapted to control wheelchairs and other types of machines.

#First Award - Society of Manufacturing Engineers
Fourth Award - General Motors ISEF

Sandwich Structures

Warner, Lisa, Lawrence High School, Lawrence, KS 66044
2417 Brookside Court, Lawrence, KS 66044

The intent of my project was to determine the strength of varied composite sandwiches and to then try to improve the composite.

I assumed that the strongest composite would posess these qualities: a perforated core, a thicker core, and a more crush resistant core and skin.

My composite samples were made by using epoxy to adhere the core and skin. The composite was placed in a vacuum bag, during cure, to insure good adhesion. I tested the strength of the structure by suspending a weight at the midpoint of each sample. I measured the weight and resulting deflection until the beam failed. Then the strength of the sample was calculated.

In conclusion, an increased foam thickness resulted in increased stiffness and strength. Perforation of the sample was of no value. The strongest cores were: urethane polyester and balsa wood. The strongest skins were carbon fiber and kevlar.

# AN INVESTIGATION INTO CERTAIN CHARACTERISTICS OF TWELVE MAJOR WOODS

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P.O. Box 1437, New Iberia, LA 70560

Modern Architectural and Engineering designs have returned to natural building materials, so knowledge of the physical, structural, compositional, and economical properties have become important. The purpose of this project is to study twelve major woods which are commonly available to architectural and engineering designers, and the properties of these woods.

The experiments conducted include density, burnrate, heat content, absorbency of water, moisture content, modulation of elasticity, hardness -9c, hardness 23.5c, hardness 85c, and price. The experiments were conducted by the use of 218 pieces of wood and their sawdust. The experiments were all administered with at least three replications and only "mean" data was analyzed. Various sizes of wood were used.

The "C Scale" and the "CR Scale" were developed to rate the woods on various characteristics. These scales show the value of each wood and are based upon the data from the practical experiments. The "CR Scale" has been weighted to select characteristics of importance for engineers. A computer program was developed for use by those involved in architectural and engineering design to help select wood types for particular applications.

#First Award - American Society of Civil Engineers
Fourth Award - General Motors ISEF

THE CONSTRUCTION OF A pH PROBE USING FIBER OPTICS

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Fiber Optics are thin glass or plastic fibers designed to carry light over long distances without the light losing any of its intensity. Because of this characteristic, fiber optics were used as light transmitters to carry light from a light source to a pH probe end containing phenol red bonded to polystyrene microspheres, and back to a detector.

When the probe end is placed in a solution with a pH between 6.8 and 8.4, light is carried from the source (Standard Projection Equipment, model # 500-C2), through the optical fibers to the probe end. There, depending upon whether the solution is an acid or a base, light is either absorbed or reflected by phenol red. The reflected light is carried to a detector where the intensity of light at 650nm is measured by a photoconductive resistor interfaced with an Apple II+ computer through the game port.

The novel pH probe was calibrated with solutions of known pH values between pH 6.7 and pH 8.5. An unknown pH solution was then tested as having a pH of 7.1. When this unknown solution was tested with a standard pH electrode, the pH was measured at 7.07. Since there was only a 0.03 deviation between the two instruments, it was concluded that it is feasible to build a pH probe using phenol red bonded to polystyrene microspheres as probe packing material, and fiber optics as light guides.

# DESIGN AND APPLICATION OF A VARIABLE-CYCLE HYDROGEN ENGINE

Pabian, David J., Camelback H.S., Phoenix, AZ 85016;
4402 N. 23rd Place, Phoenix, AZ 85016

As man depletes his fossil fuels, alternative energy sources must be found to keep a secure energy supply. Hydrogen, the most abundant element, is an excellent alternative fuel, creating less emissions when burned than the gasoline that is in use today. This experimental engine was designed to try to prove that hydrogen can be efficiently utilized in an internal combustion engine.

Discarding the idea of converting a gasoline engine, a totally different design of an engine was drawn up and built. Research was done to find problems in existing engines that were converted from gasoline, and steps were taken to eliminate them in this new design. The prototype engine is a variable cycle: one is the more common two-cycle which is found in weed eaters, and the other cycle is a single, double-acting cycle which would increase the power output when needed.

The hydrogen would be stored in metal hydrides, offering a safe means of holding and transporting hydrogen gas. The metal hydride would be charged with hydrogen; and, after the engine is started with a small reserve supply, the exhaust gas would heat the hydride releasing the hydrogen gas necessary for combustion.

Converting cars from gasoline or diesel to hydrogen would be very costly and so would a totally new design for new cars. The most economical use of a hydrogen engine would be in stationary engine-generator assemblies where the added weight of the hydride storage would not be a problem.

#First Award - General Motors Corporation

FROM OIL: OIL!

Baum, Melissa K., Eastside High School, Gainesville, FL 32601
2817 N. E. 53rd Ct., Gainesville, FL 32609

This project was to prove that oil can be reclaimed from used motor oil through simplified chemical and physical techniques.

The procedure used in this particular project was one of the student's own original concepts. This technique was simplified to abstain from complicated technicalities.

In the process, the oil went through these various steps in order to complete the entire experiment:

(1) Removal of magnetically attracted metals
(2) Filtration of bulky sludge and carbon
(3) Freezing of various impurities

The processed oil was then taken through a viscosity test to prove that this procedure was indeed effective. The unprocessed oil was used as a control to prove the results.

From these results, it appears that this method of reclamation of oil is indeed effective.

# INTELEBOT: THE INTELLIGENT WALKING ROBOT

Pearl, Steven H., Grants H. S., Grants, NM 87020
P.O. Box 728, Grants, NM 87020

Robots are becoming more and more visible at work and in the home. People who once thought of robots as being evil are now changing their attitude towards them. The robots we see in the movies are nothing like the ones in industry. Most of them can do little, but pick up and move things to a new location. A computer serves as the robot's brain, thus telling it what to do and when to do it, and in some instances, how to do it.

Intelebot is designed to explore a maze and then to plan and execute the shortest return route through the maze. Intelebot has a six leg walking mechanism that allows it to walk over small obstacles. It's basic components are an Apple IIe computer, an Interface 32, a control box, and software written in BASIC. The robot was placed at the beginning of a maze and both its initial trip time and return trip time was recorded. Since the robot moves at a constant speed, the difference in the times indicates the most efficient return trip. The experiment was run three times with three different mazes. Inteiebot had an average time of 10 minutes 16 seconds on the initial trip and an average of 5 minutes 37 seconds on the return trip. The robot had some difficulty manuevering over the obstacles in the maze. These experiments indicated that Intelebot can determine a shorter route through a maze.

#First Award - National Aeronautics and Space Administration
Third Award - General Motors ISEF

PROGRAMMABLE ROBOT ARM

Massie, Thomas H., Lewis Co. Jr. H.S., Vanceburg, KY. 41179;
225 Court St., Vanceburg, KY. 41179

This project is an application of the senses of sight and kinesthesis through the operation of a computer controlled robot arm. To achieve this application, the investigation draws upon two years of prior experimentation with different arrangements and applications of a mechanical arm. One of the advantages of this project is that the construction of the programmable robot arm has provided an inexpensive scientific inquiry. The arm itself costs nothing to construct because it is built of assorted toy parts, common household items, and salvaged junk. There are three modes of operating the arm. It can be directly controlled by a human operator pressing keys to activate various motors. The arm can also be programmed to activate various motors for different lengths of time. The third mode of operation utilizes sight and kinesthesis for movement entirely independent of a human. Once activated, the computer instructs the arm to move across the tracks on which it is mounted, locate an object, and retrieve it. Output or control of the motors is achieved through the computer screen using photoresistors and relays for switches. Input, by which the computer utilizes the photoresistor for sight and the potentiometer for kinesthesis, is read through the joystick post of the computer which measures analoy signals in the form of resistance. This type of automated arm can be utilized in aiding the disabled, working on the assembly line, or as a manipulator on remote space and ocean probes.

#First Award - National Aeronautics and Space Administration

ENVIRONMENTAL SCIENCES

TRACKING THE DISTRIBUTION OF THE NANTUCKET PINE TIP MOTH IN SOUTHEAST OKLAHOMA

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The successful growing of pines in Southeast Oklahoma calls for instant care and timely use of proper methods to provide the best control of the first generation of the Nantucket Pine Tip Moth Larva, (Rhyocionia Frustrana Comstock). This study projects the feasibility of operating a trapping system across parts of Southeast Oklahoma as a method of determining when the over-wintering population starts emerging in the spring in order to estimate when control procedures should begin. The trapping system was in operation from March 1, 1985, until September 30, 1985.

Scout insect traps were obtained from the makers of Hercon Disrupt Mating Disruptant and Population Suppressant, Health-Chem Corporation of New York. Small strips of pheromone were secured to the adhesive inside the traps. Traps were placed on outerbranches, in the mid-section of the tree. A daily log, tabulating the number of insects trapped was kept.

This study proved that a successful trapping system can be developed to determine the emergence of the moth.

Results indicate that control procedures should begin March 1 and continue every two weeks through September.

SENSITIVITY TESTING OF DIFENZOQUAT METHYL SULFATE ON THE LABORATORY RAT, PHASE II

Ruff, Angela F., Lehr High School, Lehr, ND 58460
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Dermal tests were performed on normal female rats and pregnant rats, using the herbicide Avenge. The concentrations were 1 ml of chemical to every 10 mls of water and 2 mls of chemical to every 10 mls of water. During a 21 day period, two rats recieved concentrations of the herbicide on their hips while the third was a control. Between the 10th and 14th day the rats were given the drug Ketaset as a tranquilizer. A small amount of blood was drawn from the tail to do a capillary time test. A 0.8 capillary tube was filled with the blood and the time was noted when the blood clotted. The rats with the chemical in their system had a longer clotting time than the control rats. Blood was also used to do a Unipette platelet count, The platelet counts decreased also in the rats that were exposed to the chemical. A third test that was performed was the Guaiac test to determine if blood was present in the feces.

As a follow up of last years test a rat that was preserved in formaldehyde was sent to the NDSU vet lab to confirm the researcher s hypothesis. The test revealed that there was a suggestion of pulmonary hemorrhage, splenic change in the platelet forming compartment of the spleen, and mild nephrotoxicosis in the kidney.

#"A COMPARISON BETWEEN THE EFFECTIVENESS OF A Cu BASED ANTI-FOULING PAINT AND A Cu-Sn BASED ANTI-FOULING PAINT"

Breitenbach III, A. Richard, A. E. Beach High, Savannah, Ga. 31405
8107 Waters Rd., Savannah, Ga. 31406

The purpose of this study is to determine which anti-fouling paint, copper (Cu) or copper-tin (Cu-Sn), is most effective in Georgia's Northern Coastal Waterways. This study was undertaken to provide much needed information and data to this area. The study is also the basis for future research and experimentation.

Three systems were created to represent boat bottoms. Each system or set had five 15cm2 clay tiles. Set "A" represented the control group, set "B" the (Cu) copper based anti-fouling paint, and set "C" the (Cu-Sn) copper-tin based anti-fouling paint.

The study began on 7/10/85 and lasted until 1/10/86. After a two-week development period each set was observed for its growth once a week. Set "A" was observed on Mondays, set "B" on Wednesdays, and set "C" on Fridays. From the beginning of the study, environmental tests and observations such as time, cloud coverage, weather, tide direction, water turbidity, water depth, air and water temperature, current speed, and rainfall were conducted three times per week. Two other tests, pH and dissolved copper, were conducted less frequently. All tests and observations were recorded and a pictorial history of the growth on the tiles was kept.

As a result of these tests and observations, the (Cu-Sn) copper-tin anti-fouling paint was determined to be the most effective anti-fouling paint for this area, Georgia's Northern Coastal Waterways.

This study is the result of two years of continued research with future research planned.

#First Award - United States Navy/David W. Taylor Naval Ship Research and Development Center
Fourth Award - General Motors ISEF

#POLYCHLORINATED BIPHENYLS (PCBs) IN SOILS IN AND AROUND CONTAMINATED SILOS

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Polychlorinated biphenyls (PCBs) have been used in a silo coating in Michigan and the eastern United States. These PCBs migrated into the silage and further into the milk of dairy cows causing much public concern in Michigan. A law was passed in 1983 stating that all Michigan silos had to be tested for PCBs and all those that contained even a trace had to be dismantled and sent to a suitable landfill. Further, the soil within approximately three m in diameter to a depth of 15 cm also had to be sent to a landfill. It was unknown if this soil removal method would be an appropriate and effective clean-up procedure. Taking soil samples at various locations in and around three contaminated silos, extracting the PCBs, and analyzing on a gas chromatograph, showed that concentrations ranged from 519.356 to 0.013 ppm in the soil near the silos. The 28 cm of total soil under one silo was estimated to contain only 0.23 kg of PCBs, or only 1.4% of the total PCBs applied to the silo wall. The silo wall scrapings indicated that they contained 0.01% of applied PCBs. Therefore, PCBs in a silo which is in use, have a high fugacity. Removal of soil would definitely lower the amount of PCBs, but much of the amount originally applied to the silo walls was not located in the soil and is assumed to have already escaped into the environment.

#First Award - United States Army

ACID RAIN STUDIES ON *LITTORINAS* AND SEA STARS

DeRiese, Teresa A., Franklin Public School, Franklin, NE 68939;
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Over the last few years, acid rain has become an increasingly dangerous problem in our oceans, lakes, and streams. Acid rain has been throughly studies in freshwater areas, but a literature search revealed that no research has been done on sea stars or *Littorinas*. In this research, I wanted to study acid rain in an ocean environment, and pay special attention to sea stars and *Littorinas*. It has always been assumed that the natural buffering system of the ocean would protect the organisms living there, because the ocean is such a large place that no one has been concerned about the amount of acid rain flowing into the ocean. It has also been assumed that it would take a lot of acid rain to change the pH of the ocean, enough to affect any one area. I hypothesized that by using a 10% solution of sulfuric acid, I could change the pH of saltwater enough to affect the organisms living there. A bi-divider pH trough was designed and built so the sea stars and *Littorinas* could choose between two waters, both having different pH levels, one 8.0, and the other varying between 7.0 and 6.0. The sea stars and *Littorinas* were then placed at the bottom of the trough, where both waters could flow evenly over the *Littorinas* and sea stars, and where they were able to make a choice of waters. The animal was left in the water for a ten minute time period, and the choice or choices of the animal were recorded in a daily log. When all the data was accumulated a chi-squared test was used to see if the data was significant. The results were 9 with 3 degrees of freedom using .01 as the rule of reason. This showed that the *Littorinas* and sea stars do have a definite preferance, and this preference is water with a pH of 8.0, compared to an acidic water.

DRAPERIES--A HOME INSULATOR: PHASE II

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Hypothesis. To find a drapery that will retain the most heat in the home for maximum heating efficiency.

Procedure. Obtain 5 different types of drapery material and make 2 different draperies from each--one with lining and one without. Shine a 150 watt bulb simulating the sun on the open side of a box covered with plastic wrap resembling a window. Shine the light on the box until the thermometer inside reaches a constant temperature. Record this reading in a graph. Place a drapery on the window and remove the light. Record the amount the temperature drops every 5 minutes for 15 minutes. Record these temperatures in a graph and repeat the procedure with the remaining draperies.

Observation. The drapery that held the most heat in the box was sample number 1. This drapery was dark in color and had a closer weave than samples 2, 4, and 5. Sample number 3 had a close weave but was lighter in color than number 1. Unlined fabrics compared very closely with lined fabrics. The greatest difference in temperatures between unlined and lined fabrics was 4°. Unlined samples 3 and 5 had the same amount of temperature drop in 15 minutes as lined sample 1.

Conclusion. In choosing a drapery for maximum heating efficiency, dark colored, closely woven fabrics are the best choice. Lining makes little difference in holding in the heat. For maximum heating and air-conditioning in the home, a medium-colored drapery would be advisable.

# SHIFTS IN BENTHIC AND PLANKTONIC DOMINANCE RELATIVE TO ENVIRONMENTAL VARIABILITY

Sherman, Benjamin Harrison, South Kingstown H.S., Wakefield, RI 02883; 27 Beech Hill Rd., Peace Dale, RI 02879.

A new and inexpensive system was developed, tested, and implemented for measuring change in the structure of coastal ecosystems. The system is based on measuring changes in dominance among two benthic and planktonic communities, and six physical-chemical parameters. Spatial and temporal time-series measurements were made in a salt pond, a coastal ecosystem, and a large embayment over a ten-week period in 1985 and over nine weeks in 1986. The unique physical oceanography of the three sites allowed for random collections of zooplankton using pineapple-can samplers lowered into tidally-dynamic waters. Benthos was sampled using artificial substrates (bricks) allowing for random settlement of key trophodynamic communities. Samples for chemistry were obtained by vertically deploying an opening-closing sampler. Areal differences in dominance of benthos were related to organic enrichment. Dominance patterns of holoplankton and meroplankton were within normal ranges for the region and season. Measurements of temperature, salinity, oxygen, pH, chlorophyll, and phosphates were also within expected limits for the area and season. A significant between-year difference was observed in the macrobenthic community. Bivalves that represented approximately 30% of the dominant macrobenthos on the substrates in 1985 were completely absent in 1986. A picoplankton bloom in the area apparently caused high and wide-spread mortality. The absence of bivalves on the substrates underlined the serious impact of the bloom on the coastal ecosystem and confirmed the usefulness of the inexpensive sampling strategies developed in the project for measuring ecosystem change in coastal waters.

#First Award - Bureau of Reclamation/United States Department of the Interior
Second Award - General Motors ISEF

OIL SLICKS IN THE TRINITY

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Oil in water can kill fish and plants living in it. It also contains hydrocarbons that could cause cancer in humans if the water is used for drinking. Oil can enter bodies of water in a variety of ways. A canal in the Trinity River was tested to determine the origin of the oil build up there. A pipe extending across the canal divided it and prevented most of the oil from getting to the other side. This clear side was used as a control. Water samples were taken every day to study possible patterns in the oil build up. Ping pong balls were dropped in street gutters to determine that water in the canal came from the streets. Invertabrates were used to determine the effect of oil on river inhabitants. Dye was used to ascertain if oil could be coming from automotive companies near the canal.

No obvious pattern was found in the oil samples, but litter and ping pong balls in the canal, especially after the rains, indicated some street washoff. An oily seepage ditch at the bottom of the hill on which companies with the obvious presence of oil were situated indicated the oil might come from dumping. This was supported by the dye experiment which showed that water and oil coming from the hillside did make its way to the canal. A combination of street washoff and dumping, specifically by companies near the canal, is the most probable origin of the oil.

NUTRIENT ELEMENTS CYCLING VIA DECAY OF MANGROVE LEAVES

López, Lizbette, Adolfo Grana Rivera H.S., Peñuelas, PR 00724
Box 475, Guayanilla, PR 00656

In mangrove forests, the large crops of leaves found on the forest floor suggest that their decay may result in correspondingly large amounts of essential nutrient elements being recycled from the trees back to the environment. The purpose of this study was to evaluate the importance of this process.

A mangrove forested wetland area in the Jobos Bay Estuarine Sanctuary in Puerto Rico was chosen. During the first phase of the study the diversity, density and frequency of mangrove species were determined. The most dominant species were Rhizophora mangle (5740 ind/ha and basal area of 8.0 m^2/ha) and Laguncularia racemosa (1510 ind/ha and basal area of 4.8 m^2/ha). During the second phase, field experiments were conducted with leaves of the two dominant species. Several hundred mesh bags (1mm^2 pore size and 10 x 20 cm area), loaded with 10g fresh leaves, were placed on the forest floor and six replicate bags per species retrieved at 0,2,4,8,16,32,64 and 256 elapsed days. Residual dry weight and element content were measured on the composited samples. The pattern of changeover time in the content of: 1) total mass, 2) nitrogen, 3) phosphorus, 4) potassium, 5)calcium, and 6) residual ash was analyzed graphically. In the 256 days, calcium content did not vary appreciably. Total mass and ash dropped progressively. Virtual disappearance of potassium occurred. Nitrogen and phosphorus content increased sharply over the initial 128 days. Nitrogen remained above, but phosphorus decreased below initial levels by day 256.

CHEMICAL EFFECTS CAUSED BY POLLUTANTS ON SEA ALGAE, ULVA, PADINA, CHONDRUS AND CAULERPA.

Alicea Pou, José A. - Superior Jardines de Ponce, Ponce P.R.
Parc. Quebrada Limón - Roosevelt # 44-Ponce,P.R. 00731

Many pollutants have harmful effects on marine organisms and algae. Four varieties of tropical marine algae were selected from the south area in Puerto Rico. These were placed in a half gallon tank containing salted water, sand and air pump was put inside to establish an ecosystem as close as possible to algae's own environment.

In the first phase the algae were contaminated with five cc's. of contaminants.

During the first week in the second phase thirty cc's were injected in various algae and in the second week only twenty cc's were injected into them.

After careful observation the algae were kept in Isopropanol alcohol to prepare the thin layer of chromatography.

These phtographs and chemical analyses showed the presence of contaminants in the extract taken from the algae.

The general results were that algae suffured changes in pigmentation, size, structure and reproduction as a result of their contact with the contaminants.

THE EFFECT OF FERTILIZER, LIME AND RHIZOBIAL INOCULATION ON THE GROWTH AND YIELD OF IPIL-IPIL [Leucaena leucocephala (Lam) de Wit] GROWN ON ALIMODIAN CLAY SOIL

Loot, John Horatius Gallego, Iloilo National High School
La Paz, Iloilo City, Philippines

This study was conducted to generate data on profitable ipil-ipil production on acidic Alimodian Clay Soil which predominates the barren slope lands of Iloilo Province. In terms of growth [Plant height at 148 Days After Planting (DAP) and trunk circumference at 232 DAP] and yield (trunk weight at 232 DAP), it sought to compare the following: (1) a non-acid resitant rhizobial strain (S-1) with Ammonium Chloride (AC) as nitrogen suppliers, both combined with Superphosphate (SP) and Agricultural Lime (AL)-T-2 vs. T-3; (2) SP and Rock Phosphate (RP) as phosphorous suppliers, both in the presence of an acid-resitant rhizobial strain (S-2) - T-4 vs T-5, respectively, (3) Farmers' Practice (T-1) without fertilizer nor lime nor inoculant, with the other treatments; (4) S-1 and S-2 with their respective combinations-T-2 vs T-4, respectively; and, (5) to determine which of the five treatment combinations would give the best growth and yield of ipil-ipil.

In accordance with the above specific objectives, Analysis of Variance for the Completely Randomized Design and tests of significance using the Duncan's Multiple Range Test at 5% level, showed that: (1) S-1 was similarly effective as AC; (2) SP had also similar effects as RP; (3) Farmer's Practice had similar effects as T-4 and T-5 but inferior to T-2 and T-3 on plant height, similarly effective as T-2, T-4 and T-5 but infererior to T-3 on trunk circumference, and no significant differences from the other treatments in trunk and herbage yield; and, (5) AC + SP + AL (T-3) was the best combination in growth and yield. Economic analysis however, revealed that S-2 + SP (T-4) was the most profitable combination, when all other factors of production was assumed to be equal for all the treatments.

#First Award - American Society of Agronomy
Second Award - General Motors ISEF

DETERMINATION OF PARTICULATE LEAD AND CARBON CONTENT IN AIR RESULTS OF TESTS IN CITY TRAFFIC OF BRUSH, COLORADO

Gabriel, Shawn L., Brush H.S., Brush, CO 80723
26137 County Road S.2, Brush, CO 80723.

This project was an attempt to determine if lead and carbon content in the atmosphere posed a serious problem in a rural setting, specifically, Brush, Colorado. Thirty-three sites were sampled and analyzed for carbon, lead and total particle content as well as lead concentration. Three sites were chosen for more detailed analysis due to their higher lead concentrations. These three sites were subjected to dispersal profiles both horizontally and vertically. The thirty-three sites sampled had an average of 2.7 micrograms/cubic meter lead. The dispersal profiles indicated that the concentration varied from place to place and with time; the concentration of lead varied inversely with height and distance from the streets. The number of particles didn't show a consistent relationship with the number of vehicles, but they did display a consistency in the ratios of the different size groups to the number of particles reaching the sampler.

DOES ACID RAIN AFFECT SEED GERMINATION?

Dueker, M. Elizabeth
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PURPOSE:

The purpose of this experiment is to determine the effects of the two main components of acid rain, sulfuric acid and nitric acid, on the germination rate of alfalfa seeds.

PROCEDURE:

In a series of test tubes, alfalfa seeds were allowed to germinate in various solutions. Four test tubes contained sulfuric acid at various pH´s and another four contained nitric acid at the same pH´s. A control was established when seeds were allowed to germinate in distilled water. After a two day germination period, cotyledon growth in each pH and its corresponding control was measured daily over a span of four days.

CONCLUSION:

As the pH of the two acids decreased (an increase in concentration) the germination rate of the alfalfa seeds decreased significantly. Based on these results, acid rain should be taken more seriously as a threat to our environment and ecology. Immediate, intense research to identify and reverse the sources of acid rain is needed to prevent further environmental damage.

A STUDY OF AMERICAN SAMOA'S VARIOUS DRINKING WATERS

Crookshank, Tana M., Fa'asao H.S., Pago Pago, Am. Samoa
P.O. Box 3024, Pago Pago, American Samoa, 96799

If the water we drink contains many impurities such as carcinogens, viruses, harmful bacteria, and metal pipe corrosion, it can affect our health.

It was hypothesized that the rainwater from the rainwater tank and the distilled water samples would be the purest while the village water was hypothesized to be the impurest.

Samples of rainwater from a rainwater tank, distilled water, government water, boiled government water, filtered government water, village water and boiled village water were collected once a week for four weeks. On each testing day tests for total and fecal coliform were conducted and dissolved oxygen (DO) readings were taken. The pH level of each sample was recorded and finally each sample was run through an evaporation test to determine the dissolved solids present.

The village water showed to be the most contaminated with dissolved solids and coliform bacteria. However, the rainwater from a rainwater tank and the filtered water also had high bacterial counts. This contamination of bacteria was supported by the DO reading and pH levels.

The purest water was shown to be the bottled distilled water and the boiled government water as they had no coliform and very few dissolved solids.

A perfect solution to Samoa's drinking water situation was not determined by this project as each sample was discovered to have both advantages and disadvantages.

THE EFFECTS OF TIME ON BOTTLED FRUIT

Jones, Robby, Dixie High School, St. George, Ut. 84770
571 E. 400 S., St. George, Ut. 84770

The purpose of this project was to determine whether fruit bottled at home over a period of forty years was palatable.

Apricots bottled prior to 1950 were compared with fruit bottled in the decades from 1950 through 1980. Tests were conducted to check the vacuum, acidity, consistency, taste and smell. A blind panel was used to determine whether there was a significant difference in the palatability of the fruit bottled over the decades.

After applying an Analysis of Variance test to the responses, it was determined that this panel could not distinguish a significant difference in the samples by the use of taste or smell.

A COMPARISON OF 3 TYPES OF WASTEWATER TREATMENT FACILITIES THAT INJECT EFFLUENT INTO THE ARKANSAS RIVER

Mike Bynum, Clyde Boyd Jr. High, Sand Springs, OK 74063
209 East Saddlerock Road, Sand Springs, OK 74063

The purpose of my project is to compare 3 types of wastewater treatment facilities that inject their effluent into the Arkansas River. These 3 types of facilities are: Rotating Biological Colonies (R.B.C.), Activated Sludge, and Sewage Lagoon. Part I of my experiment is the performing of 6 tests--Alkalinity, Salinity, Carbon Dioxide, Chloride, Chlorine, and pH. In part II, the same tests were performed 4 weeks later. In addition, in part II, I added the following 4 tests for additional grounds for comparison: Settleable Solids, Suspended Solids, Dissolved Oxygen, and BOD (Biochemical Oxygen Demand). The results were parallel to my hypothesis; that the plant with the most extensive treatment (which was the R.B.C. facility) would be the most effective. To summarize my conclusion, the Rotating Biological Coloniesies was the most effective of the three types in the test areas.

A SIMULATION STUDY OF THE EFFECT OF ACID RAIN ON FISH

Ma, Arnold M., Northside H.S., Muncie, IN 47304;
2608 W. Purdue Road, Muncie, IN 47304.

No exhibit.

INSULATE, ANODE OR CORRODE? WATER PIPES

Siemering, Geoffrey S., B.T. Washington H.S., Tulsa, Ok
5727 East 43rd Street, Tulsa, Oklahoma 74235

Corrosion is the deterioration of a substance because of a reaction with its environment. The cost of corrosion in the U.S. is over 10 billion dollars yearly. The City of Tulsa reports about 250 water line leaks per year. One half are due to corrosion! The purpose of this project is to determine if water pipe corrosion can be resolved and what method will be most effective. Four(4) catagories representative of typical city water line-water line connections were set up. Three(3) types of corrosion activity-loss protection was studied. Water lines having corrosion problems are carbon steel and cast iron with copper pipe service connections. The four(4) catagories are: A-Galvanized coated/carbon steel connected to copper pipe, B-Galvanized coated/carbon steel connected with a mechanical-electrical insulator to copper pipe, C-Galvanized coated/carbon steel connected to copper pipe with corrosion protection via a galvanic anode, D-Galvanized coated/carbon steel connected with a mechanical-electrical insulator and corrosion protection applied to the galvanized coated/carbon steel pipe via a galvanic anode. Moist Oklahoma clay soil was used. A D/C voltmeter measured the corrosion and corrosion protection activity. An identical group of samples was used to measure interval weight loss to substantiate the data from the D/C measurements. The D/C readings confirmed by the weight loss tests showed: A-Had the most active corrosion, B-Had a greater reduction of corrosion than A and C, C-Had less corrosion activity than A, D-Had the least corrosion activity. This shows that corrosion activity and metal deterioration can be reduced and controlled by using protective devices.

LICHENS: A LINK IN DETERMINING THE PRESENCE OF ATMOSPHERIC POLLUTION?

Sweigart, Kimberly N., Lampeter-Strasburg High School, Lampeter, PA 17537; 304 Wynwood Drive, Willow Street, PA 17584

An article in the January/February issue of Science 86 Magazine provided the inspiration for this project. This article described how lichens (small protists composed of an alga and a fungus in a symbiotic relationship) were being used in Europe and in parts of the United States to determine the amounts of pollution in the air. Lichens absorb both nutrients and pollution from the air. They use the nutrients, but the pollutants are trapped in their cells. An analysis of lichens from various areas of Pennsylvania for their lead content formed the basis of this project.

Lichen samples from different areas of the state were gathered and chemically digested into solutions. These lichen samples were tested by atomic absorption spectrometry and absorption readings were obtained. These readings were then converted to lead content in parts per million.

Results showed that samples from wooded areas had a low lead concentration; however, not all samples taken from industrialized areas showed high concentrations. A very high lead level was found at Franklin and Marshall College in Lancaster which showed a concentration of 243.27 parts of lead per million. Exact atmospheric pollution levels can not be determined directly from these results because the age of each lichen would have to be considered to do so.

FUNGAL DEGRADATION OF INDUSTRIAL PAPER WASTE

Brown, Rachel Susan, Keyser High School, Keyser, WV
1440 Funderburg Street, Keyser, WV 26726

The bleaching of wood pulp with chlorine, which is used to obtain maximum whiteness of the pulp, produces a colored bleach effluent. Federal water pollution laws in the United States currently do not regulate the discharge of color from pulp and paper mills. The problem is to avoid contamination of rivers and groundwater with this effluent.

Although almost every U.S. pulp mill has a biological wastewater treatment system, these systems are ineffective in the degradation of color. The lignin, which is the structural substance of pulp and produces the color, fails to be degraded during this process.

The purpose of the experiment was to use Phanerochaete Chrysosporium commonly known as "white rot fungus," a fungus known to degrade lignin, to breakdown the effluent. A "white rot fungus" culture was obtained from U.S. Dept. of Agriculture, Forest Proudcts Lab. This culture was subcultured, inoculated to obtain maximum growth and then combined with the effluent. The sample effluent was obtained from Westvaco after it had passed through the pulp mill's wastewater treatment plant. This effluent is what passes directly into streams and rivers.

Four areas of testing, done at three-day intervals, were turbidity and color utilizing a spectrophotometer; pH utilizing a pH meter; and dry weight utilizing an electronic analytical balance, for a total period of 15 days. Following this period of testing, conclusions were drawn that "white rot fungus" does show the ability to degrade lignin, thus producing less color and turbidity of effluents into rivers.

A process could be developed to use "white rotters" in pulp mill operations since the white rot fungus can be readily and economically cultivated.

DEVELOPMENT OF A SYSTEM TO REMOVE THE USABLE PRODUCTS FROM COAL ASH USING A MODEL COAL BURNING FURNACE

St.Clair, John T., Sunnyside H.S., Sunnyside, WA 98944;
521 16th St., Sunnyside, WA 98944.

OBJECTIVE: The objective of this project is to develop a system to remove the useable products from various coal ashes. The most economical method of removal was also researched.

PROCEDURE: U.S. Coal samples were obtained, classified, and ashed. The ashes were analysed using an AA Spectrophotometer and a ICP for 32 trace elements and 9 major elements. Total radiation was tested with a geiger counter. The percent metal was used to make yield predictions.

The metals were removed from the ash after leaching with H_2O to remove the soluables. The solids were filtered. The leachate was treated with $CO_3^{=}$ to produce solid Ba,Sr, and Ca carbonates. The Mg,K, and Na remained in solution. This solution was treated with OH^- to produce $Mg(OH)_{2(s)}$. This solid was filtered, heated, and reduced to Mg. H_2SO_4 was added to the remaining solution in order to make sulphates for fertilizers. The original solids were treated with OH to remove the Al. The Al ion was converted back to Al_2O_3 in order to be reduced to Al. The TiO_2 was separated from the Fe_2O_3 and SiO_2 and reduced to Ti.

RESULTS: The coal samples contained 25 trace elements and nine major elements. The bituminous coals had more Al,Ti, and Mg content and more trace elements than the other samples. The anthracite had less Si per gram than bituminous and contined high Al. Montana coal had the highest amount of Sr,Ba,B,Al,Ti, and Mg. Lignite and Sub-bituminous coal contained the same elements in similar quantities.

CONCLUSIONS: The coals with high amounts of soluable materials would make excellent fertilizers when concentrated. Bituminous has high amounts of Al,Mg, and Ti which have economic value. The Montana coals would be most profitable to recover useable metals because of high amounts of strategic metals.

#THE EFFECT OF THE TOXIC CHEMICAL, $CuSO_4$, USED IN RESERVOIRS ON FISH GROWTH. A 4-YEAR STUDY.

Tongier, Elizabeth M., Warwick H.S., Newport News, Virginia 23601
44 Brandon Road, Newport News, Virginia 23601

Water pollution has been defined primarily in terms of industrial waste and toxic chemical leaks; however, the intensive chemical treatment of our reservoirs and water supplies with metal compounds such as Copper Sulfate may have equally damaging effects on the aquatic life in these ecosystems. In a continuation and expansion of my previous work, the weights, lengths, sex, and ages of three species of fish; Largemouth Bass, Bluegill, and Yellow Perch, were compared from two local $CuSO_4$ treated reservoirs (Waller Mill and Lee Hall). In addition, liver samples from Yellow Perch from both lakes were chemically analyzed for Cu contamination. The average yearly dosage of copper sulfate for Lee Hall was found to be 26 times higher than that for Waller Mill. In all three species studied, the fish from Lee Hall were 27% less in weight than Waller Mill fish. The pattern has persisted of the greatest growth effects occuring between the ages of 2 through 6 years with the order of effect being: 1 Yellow Perch (most affected), 2. Bluegill, and 3.Bass. Copper measurements show significant levels (400+ ppm) detected in the livers of 58% of the fish examined from Lee Hall with 92% of these fish being in the 6 to 8 year group. These results indicate a continuing significant and progressive growth retardation with species specificity in the heavily treated reservoir with $CuSO_4$ as the probable cause. The target organ appears to be the liver with the probable dysfunction being enzyme inhibition in the mitochondrial cytochrome system resulting in reduced ATP production, defective metabolism, and retarded growth.

#Honorable Mention - Bureau of Reclamation/United States Department of the Interior

PETROLEUM : ELIMINATION FROM GROUNDWATER

Carley, Todd M., Wamego H.S., Wamego, KS 66547;
1601 West Sixth St., Wamego, KS 66547.

In recent years, we have been overtaken with the problem of groundwater pollution. One such pollutant is that of the petroleum that we use everyday. In the experiment, three types of substances were chosen to resemble the ones found underground. The three were: a soil/gravel mixture, peat moss, and marbles. These were then placed into three different cylinders and given 1,000 ml of water. A pore volume test was done to find out how much water and petroleum was to be used. An amount of 300 ml was found. Then 300 ml of unleaded gasoline was poured into each cylinder. This was then followed by 300 ml of water every 24 hours. Before pouring another 300 ml of water into the containers each 24 hours, the liquid that had been excreted out of the cylinders was smelled and then tasted for signs of petroleum. An up-to-date conclusion states that the marbles are flushing out the fastest with almost no smell but a slight taste, the soil/gravel has both a slight smell and a slight taste, and the peat moss is still holding some of its liquid thus causing a strong smell and taste.

# REHABILITATION OF CONTAMINATED GROUND-WATER AQUIFERS: METHODS, CONSIDERATIONS AND CONSTRAINTS

Terri Newport, Stratford High School, Stratford, OK 74872
Route #2, Box 81, Stratford, OK 74872

In 1985, the U.S. Environmental Protection Agency estimated that over 10,000 uncontrolled hazardous waste sites existed in the United States. Clean-up of these sites could take 50 years, at a cost of over 100 billion dollars. Currently, 812 sites have been placed on the National Priority List and are scheduled for remedial action. Ground-water contamination was the primary consideration in priority ranking of hazardous waste sites. Rehabilitation of contaminated ground-water aquifers is a major national concern.

Specific objectives of this research project were to develop and demonstrate, using physical ground-water flow models, improved methods to identify, isolate, and rehabilitate contaminated ground-water aquifers and to generate data supporting these methods and identifying their limitations. This was accomplished using five physical models designed and operated to duplicate actual aquifer conditions of ground-water flow, contaminants entering the aquifer, contaminant transport and contaminant removal. These models, constructed of plexiglas and filled with aquifer sand material, were then selectively fitted with injection and pumping wells, which permitted sampling for contaminant concentrations, determination of model flow rates and the recording of visual observations throughout the model. Using data generated by these models, rehabilitation strategies were developed, their effectiveness demonstrated, and their limitations identified and documented. Application of this research to real world situations will provide an economical and efficient method for restoration of contaminated ground-water aquifers.

#First Award - Association for Women Geoscientists Foundation
First Award - Eastman Kodak Company
Scholarship - Ohio State University
Second Award - National Water Well Association
Third Award - American Society of Civil Engineers
Fourth Award - General Motors ISEF

WATER POLLUTION: AN ENVIRONMENTAL SURVEY OF THE NATURAL SURFACE WATERS OF WESTERN KENTUCKY

Porterfield, Keith E., Trigg County High School, Cadiz, KY 42211
Route 4 Box 187-A, Cadiz, KY 42211

The National Wildlife Foundation performed a study of the environment and found the quality of the country's water to be bad and getting worse. It found that nearly every tributary in the country was polluted to some degree.

In this experiment, forty-three water samples were taken at random from the seven Western Kentucky counties of Caldwell, Christian, Crittenden, Hopkins, Lyon, Trigg, and Webster. The water samples were divided into two sets: those samples taken from farming areas and the ones taken from coal mining areas. The waters were then tested for nitrate, iron, pH, phosphate, and sulfate, and the results of the samples taken from farming areas were compared to the results of those samples taken from mining areas by use of the t-test.

No significant difference was found for nitrates, iron, or pH. A significant difference was found for sulfates and phosphates.

In both farming and mining areas, iron and phosphate levels were unacceptable; sulfate levels were high in mining areas. The data from this investigation supports the premise that there is cause for concern for the environment in the seven designated counties of Western Kentucky.

DANGERS OF NATURAL RADIATION: LUNG CANCER CAUSED BY INDOOR RADON GAS

Hackney, Allen Lee, Jr., South Vigo H.S., Terre Haute, IN 47802;
3737 So. 7th Street, Terre Haute, IN 47802

Radon-222, a colorless, odorless, naturally occurring radioactive gas has been found to cause lung cancer in uranium miners. Agencies such as the EPA and State Boards of Health are becoming involved in radon testing programs for the home. Soil gas enters the home through openings in the basement or crawl space. In the lungs, radon decays to form radon daughters which release cancer-causing alpha radiation. Before this project, almost no radon testing had been done in Indiana. Through various newspaper articles and handouts, the general population of Vigo County, IN, was presented with information concerning radon. Detectors were purchased from the University of Pittsburg and re-sold at cost. A number of homes have been tested; results show that the average level was 2.9 pCi/l, the high was 4.9 pCi/l, the low, 0.9 pCi/l. These levels are not considered hazardous, but enough radon was found to suggest further testing, especially of new, well-insulated homes. The State Board of Health will be re-testing homes with over 4.0 pCi/l. An extensive literature search was undertaken to find information on radon detection. A detector was then developed using a design similar to that of the U. of Pittsburg. This design was the most feasible when cost, size, power source required, exposure time, and accuracy were considered. Prototypes of this diffusion barrier charcoal adsorption detector were exposed for one week and analyzed using a NaI scintillation counter at Indiana State University's Radiation Counting Lab. Radon concentration was determined by counting the gamma radiations of Pb^{214}, a radon daughter. These prototype detectors showed insufficient quantities of radon to accurately determine the radon level. The re-evaluation and improvement of this detector is currently in progress.

# THE ENVIRONMENTAL IMPACT OF EFFLUENT ON WATER QUALITY OF THE GREAT MIAMI RIVER, BEFORE AND AFTER

Sherman, John A., Vandalia-Butler H.S., Vandalia, Oh., 45377
146 Hartshorn Drive, Vandalia, Ohio 45377

The quality of water in The Great Miami River is a concern from recreation and wildlife welfare to the more immediate threat of contamination of human water supplies. A 3½ mile section of the river was studied. Four specific sites with similar habitat were selected in September, 1984. Macro, micro and chemical analysis have been conducted regularly to date. The section of river being studied has been found to contain two depression zones due to effluent discharges from sewage treatment plants. One of the zones is located in Tipp City and the other in Vandalia, Ohio. Both biotic and abiotic qualities of the water and the surrounding habitat have been studied. Qualities that were tested include pH, amonia, temperature, and dissolved oxygen. Other methods of monitoring include The Biotic Index and using algae as a pollution indicator. Experimentations such as mapping the depression zone by tracking suspended solids and studying the effect of specific impurities on algae were conducted. Results obtained were very effective in determining the extent of the pollution impact and possible solutions to the problem. The investigation of how and at what rate does an aquatic habitat recover once effluent discharge has been eliminated, is also considered to be very significant in the understanding of the total pollution impact on the aquatic environment. In November, 1985 Tipp City and Vandalia sewage treatment plants were shut down. A comparative study of pollution impact and recovery rate was investigated.

#First Award - Water Pollution Control Federation

#DO TRIBUTARIES AFFECT PERIPHYTON GROWTH?

Dew, Tamera S., South Sumter High School, Bushnell, Florida 33513
P. O. Box 1081, Bushnell, Florida 33513

The food chain in the Withlacoochee River begins with periphyton, microscopic plants and animals. These microorganisms are vital to all other life in the river. The purpose of this study is to determine how certain environmental conditions affect growth of periphyton. My hypothesis is two-fold. (1) Biomass along the Withlacoochee River will change. (2) The Jumper Creek Canal and Little Withlacoochee River tributaries will contribute to this change.

This experiment involved visiting seven testing sites along a 65 mile reach of the Withlacoochee River once a month to take the following measurements: dissolved oxygen, carbon dioxide, pH, and temperature of the water, plus pH of the soil. Samples of periphyton growth were also collected using artificial substrates at each site. Two of the project sites on the Withlacoochee River were south of the tributaries, and two were north of them. The two sites south of the tributaries were used as a control and as a basis for observations over a period of six months.

Periphyton growth increased with warmer temperatures and flooding in August and September. Heavy rains aided periphyton growth by washing nutrients into the river. Heavy rains also reduced the dissolved oxygen in the water to a level which caused fish kills. This broke the food chain and allowed periphyton to increase.

Through this experiment, it was discovered that biomass fluctuates at all the sites during the experimental period. The tributaries contributed to changes in biomass. Although the periphyton growth in the tributaries was high, the overall growth decreased as the waters fed into the Withlacoochee River.

#Fourth Award - General Motors ISEF

# CAN A CHARCOAL FILTER REDUCE THE EFFECTS OF AUTOMOBILE EXHAUSTS ON CHICK EMBRYOS?

Haines, Libby, Russellville High School, Russellville, KY 42276
Route 3, Box 387-E., Russellville, KY 42276

Prior years of research offered proof of the undesirable effects of leaded and unleaded automobile exhaust fumes upon the development of chick embryos. This project focused upon filtering the leaded and unleaded exhaust fumes through charcoal to determine if the effects upon chick embryos could be significantly reduced.

A filter was constructed using a twelve inch plastic pipe with four pieces of chopped charcoal. It was placed as an extension of the exhaust pipe on two cars - one using leaded and the other using unleaded gasoline. Seven eggs each were placed in five Zip-lock plastic bags. Fumes were collected in the bags from the cars without benefit of the filter and with the filter. One bag of seven eggs was not exposed to any fumes; this bag was the control.

The filter greatly reduced the harmful effect of the leaded and unleaded exhaust fumes. This is substantiated by increased crown to nose length in the chick embryos. Growth of the chick embryos as measured from crown to nose varied from 6.364 mm in the control to 2.7 mm in the leaded gasoline exhaust fumes without filter.

A suggested, effective method to reduce air pollution would be to design a "throw away" charcoal filter to attach to the end of the exhaust pipe.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

# THE EFFECTS OF LIGHT INTENSITY AND SULFUR DIOXIDE ON STOMOTAL APERTURE OF ATTACHED LYCOPERSCIUM LEAVES

Jensen, Janna Leigh, Clearfield H.S., Clearfield, UT 84015;
982 N. 450 W., Sunset, UT 84015

By using direct observation of attached tomato leaves, stomotal responses were measured in response to light intensity and SO_2 in klux units. A porometer was used to make the measurements by a continuous observation technique. This technique enables continuous observation of a single stomate. The damage from sulfur dioxide and light intensity was measured, plotted, and single stomates of attached tomato leaves were photographed. The poromerer has a microammeter, battery, SO_2 canister, gas-exchange vents and a three-way regulatory tap. Sulfur dioxide can cause complete closure and collapse of a single stomate in 40 minutes. When klux units of 20 to 50 are used there is very little aperture variance. Also, 30 klux units can close the aperture of a single stomate. As the klux units are decreased, the aperture increased from 0 back to 3.2 microns. By using continuous observations of a single stomate meaningful data on the effects of air pollutants, such as sulfur dioxide, can be studied.

#Alternate - United States Department of Energy

A COMPARATIVE STUDY OF TOXICITY OF FRESH AND SALT WATER FISH

Van, Alex Hung C., Alhambra H.S., Alhambra, CA 91801;
1581 College View Drive, Monterey Park, CA 91754.

No exhibit.

ORDINARY ANTIDOTES FOR EXTRAORDINARY ANTS

Kelley, Greg, Opp High School, Opp, Al. 36467
Route Three, Opp, Al. 36467

The subject of this study was the ever increasing problem of fire ants (Solenopsis invicta) in Alabama. Ordinary household products were utilized in an effort to find a substance that would accomplish the purpose outlined in these questions.

1. Is there a common household product that would kill or repel fire ants?
2. Could this be used for one or two mounds of ants in city lawns or flower beds without damage?
3. Would this product be cheap (moneywise) and easy (application wise) for anyone to use it?

Lab and field tests were performed, observations and records recorded.

QUALITATIVE STUDY OF THE WATERS OF THE NORTHERN AREA OF P.R.-PHASE II

Santini, Nelson R., Colegio De La Salle, Box 518, Bayamon, P.R. 00619
4th. St. #J-23, Valparaiso, Bayamon, Puerto Rico, 00619

The environmental contamination of the water bodies of our nation is a fact which has gathered importance in recent years. The goal of this investigation is to determine the degree of contamination, organic and inorganic means, of the waters of the Lake of Levittown, which was found to be an area of extreme contamination in the first phase of this study. Once determined the degree of contamination of this lake, try to find the origin and a possible solution to this problem. The parameters used in this investigation were: fecal and total coliforms for the bacteriological part and arsenic, barium, cadmium, chromium, lead, selenium and silver for the inorganic part. The results showed that the Lake of Levittown has an extremely high level of contamination that puts in danger the equilibrium of this ecosystem. The reasons of this contamination may be the effect of household, pluvial and commercial water discharges in the lake, and also due to the fact that this lake has no water currents nor an appropiate communication with open sea. For this reason, the study includes a new devise to make water currents in lakes such as this one, to improve the condition of the ecosystem by creating a flow and re-flow of clean water in the lake.

#A STUDY INTO THE EFFECTS OF THE INDUSTRIAL IMPACT ON SELECTED AREAS AND ECOLOGICAL SYSTEMS

Louque, Dalton, Lutcher H.S., Lutcher, LA 70071;
Rt. 1 Box 590-A, Paulina, LA 70763.

The purpose of this project was to analyze air, water, and soil samples in St. James Parish for chemical contaminants. PHASE I--water testing for pH, mercury, lead, nitrate nitrogen, phosphorus, BOD, phosphates, fecal coliform, nitrates, cadmium, copper, arsenic, and zinc--showed all stipulations met with E.P.A. standards. PHASE II, soil testing, found the average cation exchange capacity and percent base saturation were below normal and pH average. Potassium, nitrogen, and phosphorus amounts met with E.P.A. standards. PHASE III testing, conducted with a gas chromatograph, showed total suspended particles, sulfur oxides, carbon monoxides, nitrogen dioxides, ozone, hydrocarbons, and lead met with E.P.A. standards. PHASE IV indicated crawfish and goldfish both had susceptibilities to 11 parts acid per 1 million parts H_2O. PHASE V indicated alpha and beta particles in water were below normal. Water was not analyzed for gamma rays. Soil samples showed alpha and beta particles slightly higher than E.P.A. stipulations. Also, gamma ray levels in water were higher than E.P.A. standards. PHASE VI exposed Staphylococcus Albus, Alcaligeneses Albus, and Escherichia Coli to UV radiation for 2-minute intervals for 15 minutes showing the average number of colonies magnified 250 times to be 18. After exposure, colony counts were reduced to 4 with mutations. In conclusion, St. James Parish is within the maximum range of chemical pollutants. Overall, industries in the parish have sufficient waste monitoring equipment for protecting the environment.

#First Award - General Motors ISEF

CRYOGENICS AND MAGNETISM-EFFECTIVE PETROLEUM AND CHEMICAL CLEAN-UP

Kihlstadius, Christopher L., Box Elder High School, Brigham City Utah, 84302
316 Linda Way, Brigham City, Utah 84302

Petroleum and Chemical spills can cause severe damage to the environment immediately or in the future. The problem is to find a method of Clean-up that has no ill effects on the environment while it cleans up almost 90% of the spill. To find a method that works as well on the water as it does on land. My project is designed to do this. It utilizes the properties of liquid nitrogen and iron(magnetism) to clean the spill. The procedure is very simple. You first spread iron filings over the spill then the spill is immediately frozen using liquid nitrogen (-195 C). A magnet is then used to pick up the frozen mass and placed into storage for later recovery or disposal. The results in using this method prove to be over 90% recovery of petroleum on both land and water. This method was almost 99% accurate on land for chemicals, but was useless in water environments. With this method no human hands needed to touch the Petroleum or the Chemicals. This method is also useful in cleaning toxic Chlorine spills, because the freezing point of Chlorine is -100 C and the boiling point of liquid Nitrogen is -195 C. Liquid nitrogen brings space like environments to the earth and makes possible the safe Clean-up of specific spills in specific environments to be safe as well as extremely efficient.

GAS CHROMATOGRAPHIC AND INFRARED SPECTROSCOPIC ANALYSIS OF CITRUS PEELING EXTRACT

Anderson, Devina May, Mankato East High School, Mankato, Minn. 56001
124 Thayer Ave., Mankato, Minnesota 56001

Citrus fruit peeling extracts were taken from fresh oranges, lemons, and grapefruits. The outer layer of the epidermis was removed as this layer contains oil producing glands.

Extracts collected were then placed in air tight vials and refrigerated. Extracts were separated by the Gas Chromatography unit and recollected in a collection vial. The collected compounds from each individual peak were then analysed in the Infrared Spectroscopy unit. Scan graphs were made to determine composition of unknown substances in the extracts.

Limonene was identified as one of the compounds in all three types of citrus fruit peeling extracts. A scan graph of pure limonene was used in comparing and making positive identification of this species. Vinyls, ketones and aliphatics were isolated but positive identification continues with my research at this time.

Limonene was found to be lethal to Drosophila in 100 per cent concentrations when applied to the dorsal side of the thorax of Drosophila. Limonene applied in 100 per cent concentrations to the epidermis of bean plants traumatized the cells and eventually killed them. Limonene, a component in all three citrus fruit extracts, appears to be an effective pesticide with Drosophila and an effective herbicide with bean plants.

Compounds in citrus fruit peeling extracts can be isolated and identified with Gas Chromatographic and Infrared Spectroscopic analysis. Positive identification of limonene has been made as one of the compounds in the extracts. Separation and partial identification has been made on several others.

THE BIODEGRADATION OF OIL: A SLICK NEW IDEA

Dingman, Charles, Yucca Jr. H.S., Clovis NM 88101
1111 Fairway Terrace, Clovis, NM 88101

My research project attempted to find a specific bacterium that would biograde oil without harming plant and animal life. This may enable man to effectively deal with oil slicks in oceans, lakes, and rivers.

The procedure consisted of six major steps. 1. Took water samples from Santa Fe Lake near Clovis, New Mexico. 2. Cultured ten samples of the oil polluted water. 3. Isolated pure colonies of the three different types of bacteria that appeared in the water samples. 4. Made stock cultures of the isolated pure cultures. 5. Tested each of the three types of bacteria to determine biodegradation effectiveness. 6. Tested each of the three types of bacteria to determine if they kill aquatic microorganisms.

One bacterial strain was effective in biodegrading the oil without harming the water microorganisms. After four weeks this strain had biodegraded 36% of the oil. With ten thousand oil slicks occurring annually in and around the United States alone, this type of research takes on an increased urgency.

STUDY FOR THE PRESENCE OF TOXIC METALS ON HUMANS

Nieves-Castro, Rafael A., Dra. Maria Cadilla H.S., Arecibo, PR 00612; HC 03, Box 19445, Arecibo, PR 00612.

No exhibit.

SULFUR: DOES IT AFFECT MICROBIOLOGICAL ACTIVITY IN SURFACE WATER?

Dorriety, Alison L., Escambia County High School, Atmore, AL 36502;
P. O. Box 1303, Atmore, AL 36504.

The purpose of this experiment was to test the effects of sulfur on microbiological activity in water.

Water was removed from a nearby stream which was contaminated by means of sewage. A bacteria kill study was performed. This was accomplished by adding various amounts of sulfur to bacteria plate cultures.

The results of this experiment reflected an increase in the growth of bacteria as sulfur was added up to certain concentrations.

Due to the noted increase, it is therefore concluded that sulfur does increase microbiological activity in surface water when introduced at certain concentrations.

# COMPARATIVE STUDY ON THE EFFECTS OF HERBICIDES AND NH_2CONH_2 ON THE NODULATION OF R. JAPONICUM

Schroeder, Jonette J., Caledonia H. S., Caledonia, MN 55921;
611 North Kingston Street, Caledonia, MN 55921.

Hypothesis: Do herbicides and urea affect the nodulation of *R. japonicum* when applied at manufacturers' recommendations? This is a four-year study.

Herbicides control the growth of unwanted grass and broadleaf weeds. Urea, the water-soluble end product of nitrogen metabolism, supplies plants with a nitrogen source during growth.

R. japonicum is an important soil bacterium which lives symbiotically in nodules on soybeans and fixes nitrogen in a useable form for plant use. No herbicide carry-over existed in the Fayette soil used. Hardin brand seeds were inoculated with known *R. japonicum* and planted in ten test plots. Urea was massed and applied directly to the soil during planting. Four herbicides were diluted and applied to test plots prior to emergence. Stem growth and precipitation were measured during an eight-week growth period. Fifty plants from each plot were dug and nodules removed. The nodules were dried, counted, measured, and weighed. In the laboratory, control nodules were sterilized, crushed, and cultivated on a mannitol-phosphate broth. Each mannitol-phosphate agar plate contained urea and a herbicide diluted to the manufacturers' recommendation for the area of each petri dish. Incubation period was 24 hours at 70°F. Surface colonies were counted.

Field and lab tests showed that herbicides decreased nodulation and colony growth. A decrease in growth rate, nodule weight and colony growth due to the hydrolysis of urea was present. Use herbicides only when needed and apply urea when weather conditions are suitable.

#Third Award - General Motors ISEF

FIRE ANTS: A POSSIBLE ECONOMIC DISASTER

Miller, Andreas, Harlingen H. S., Harlingen, TX 78550;
1322 Magnolia Court, Harlingen, TX 78550

In many areas of the United States the citrus fruit industry is an important part of the economy. Therefore any factor that can contribute in the decline of commerically usable fruit can have a major economic impact. One such factor is fire ants.

Fire ants in themselves are not damaging to the fruit, however they are involved in supporting aphid populations that in the course of their feeding destroy the marketability of the fruit. The ants bring about this event by effectively eliminating insect populations that normally prey upon the aphids; thus is a double purpose fulfilled by the protectiveness of the ants. On the one hand, aphid populations boom, allowing a ready supply of honeydew (a carbohydrate secretion produced by aphids from the fruit's natural sugars) for use by the ants in feeding larva. On the other hand, the rival insect populations that were destroyed are used in feeding the rest of the colony.

It has been discovered that areas of citrus which contain fire ant colonies have an increased incidence of aphid infestations. The fire ants disturb the normal predator/prey relationship, and this allows the vast proliferation of aphids. The damage to citrus as a result of fire ant supported aphid infestations is still relatively minor. However, if the problem is not controlled, it may careen into a major factor in the economic losses suffered by citrus growers.

#3-YEAR CREOSOTEBUSH STUDY: MICROBICIDAL EFFECTS, TLC, ANNUAL RINGS, AND ENVIRONMENTAL RESEARCH; GORDON, MARK ROBERT; CENTRAL HIGH SCHOOL; 4525 N. CENTRAL AVENUE, PHOENIX, AZ 85012; 5637 NORTH 13TH DRIVE, PHOENIX, AZ 85013.

I conducted four tests this year in my research with the desert plant creosotebush (*Larrea*). The microbicidal potential of the plant's extract on six microbes was tested. Using the TLC assay, the fungicidal components of the extract on *Cladosporium cucumernum* were noted. The growth ring pattern of the creosotebush was examined. I studied the similarities and differences between urban and rural creosotebush ranges.

I have found that the creosotebush extract is a successful microbicide of 3 species of athlete's foot (*Trichophyton mentagrophytes*, *Trichophyton rubrum*, *Microsporum canis*), *Bacillus subtilis*, and *E-coli*. *Saccharomyces cerevisiae* (yeast) was mostly unaffected. Nine of sixteen noted chemical component divisions of the creosotebush extract inhibited the growth of *Cladosporium cucumerinum*. Creosotebushes at the bottom of a wash and the base and top of a north slope had the greatest annual growth. Urban-grown creosotebushes do not seem to have as strong of an inhibitory effect as rural-grown creosotebushes. The rural plants, unlike the urban plants, were spaced in an almost-perfect pattern.

Six tests were conducted in the 1984-1985 school year. The germination rates of both Sonoran and Chihuahuan, coated and hulled creosotebush seeds were noted. I determined the optimum temperature for germination of both coated and hulled seeds. In my research, I proved that cutting the plant serves as a fast means of propagation. The effects of creosotebush leaves and twigs and carpels upon various outdoor plants were tested. This last test was an extension of my research during the 1983-1984 school year.

#First Award - General Motors ISEF

#SEED GERMINATION IN METALLIC SALT SOLUTIONS

Tolbert, Sara, Boulder H.S., Boulder, CO 80302
444 Kalmia Avenue, Boulder, CO 80302

Metal ion contamination of the environment is a significant problem for our technological world. Leachings from mine tailings could inhibit plant germination and growth, and lead from automobile exhausts could affect plants growing along major highways. This experiment tested the toxic effects of metal ions on seed germination and early plant development. Lentil and wheat seeds were germinated in solutions of $AlCl_3$, $BaCl_2$, $CuSO_4$, $CaCl_2$, $[Pb(C_2H_3O_2)_2]$ and NaCl. Dilutions of 5.0%, 0.5%, 0.05%, 0.005% and 0.0005% solute were used. A parallel experiment was performed using tomato seeds and molar concentrations of the same salts ranging from 0.4 to 0.0004 M. While aluminum was the most toxic element tested, copper was also quite toxic. Barium also inhibited growth to a lesser extent. Lead was quite toxic on a molar level, but less toxic on a percent level. Except at high concentrations, calcium and sodium acted as a fertilizer. The copper not only prevented germination, but stunted the growth of the hypocotyls. The surprising low toxicity levels of these metal ions in plants shows that the plants will grow in contaminated soil.

#First Award - Eastman Kodak Company

ELEVATIONAL DISTRIBUTION OF POLLUTANTS IN THE SALT LAKE VALLEY

Tall, Brenda J., Roy High School, Roy, UT 84067
1972 W. 4335 So. Roy, UT 84067

I have studied the manner in which pollutant concentrations accumulate in the atmosphere, and have formulated a theory which explains the distribution of pollutants in the Salt Lake Valley of Northern Utah. Through my research I developed three hypotheses which related the manner in which CO and NOx disperse in a valley. These hypotheses are: 1) CO and NOx accumulate in the valley in horizontal elevational layers, 2) CO and NOx accumulate in the valley in layers that hug the contours of the ground, 3) CO and NOx accumulate in a layered bowl effect in which the pollutants hug the contours of the ground and the layers thin, rising up the slopes of the foothills.

To test these hypotheses, I formulated three experiments. Data from these experiments was correlated in order to establish a plausible picture of the distribution of these gases in the atmosphere. First I measured pollutant levels on the valley floor and up the valley slopes in order to determine if pollutant concentrations vary at different elevations. Sampling occured periodically during the winter of 1985 and 1986. I measured pollutant levels for one hundred foot elevational increments from the valley floor. To do this I constructed a helium balloon from visqueen plastic and lifted five hundred feet of tubing into the air. As the balloon rose, I pumped samples of air to my test device on the ground. Ground level samples were taken on the valley floor and up the valley slopes.

Interpretation of my experimental data supports the layered bowl effect theory in the Salt Lake Valley. Understanding this effect is important in reliable and accurate measuring of pollutants. An understanding of layering and distribution of pollutants allows for more meaningful interpretation of air quality data.

USING LICHENS AS INDICATORS OF AIR POLLUTION

Gwinup, Paul D., Greene Co. Tech H.S., Paragould, AR 72450;
Route 1 Box 193, Paragould, AR 72450

Lichens, an association of fungi and algae, are among the most remarkable and successful examples of mutualism, a type of symbiosis, to be found in nature. The correlation of the lichen absence with the occurrence of air pollution, mainly sulfur dioxide, has been well demonstrated. The degradation of chlorophyll in lichens, from sulfur dioxide exposure, has been developed into a method for estimating air pollution patterns by finding the relative amount of air pollution to which lichens have been exposed. Lichens from Northeast Arkansas and around Little Rock were sampled and tested for chlorophyll degradation. The samples collected were divided into four ranges of degradation. Of the 67 samples collected, four samples fall in the range of heavy degradation, twenty-six samples fall in the range of moderate degradation, thirty-four samples fall in the range of light degradation, and three samples fall in the range of very light degradation. The average degradation for Northeast Arkansas falls in the range of moderate degradation, indicating that this area does not suffer from a high degree of air pollution. However, higher values have been found from Little Rock into Northeastern Arkansas, indicating that airborne pollutants are being released and carried long distances before falling back to the surface of the earth. The lowest values for the percentage degradation generally occur in rural and agricultural areas where there is little pollution.

# ENVIRONMENTAL TOXICITY TESTING PHASE III: ETHYLENE DIBROMIDE LIMITATIONS WITH A NEW XENOPUS INDICATOR SYSTEM

Jansen, Douglas A., East Noble H.S., Kendallville, IN 46755;
244 Burnam St., Kendallville, IN 46755.

This research was designed to determine both the minimal concentration point at which no Ethylene Dibromide toxicity was exhibited in *Xenopus laevis* and to identify, histologically, the happenings within the systems of the tadpoles. Two adults were mated and tadpoles obtained. Twenty tadpoles were placed into five concentrations including deionized as control at both hatchling and the mid-metamorphic stage of life. The tadpoles were observed daily for the following: (1) morbid and viable tadpoles, (2) length of tadpoles, and (3) heartrates of tadpoles.

The data reveal that as the concentration increased the survival rate decreased in both stages of tadpoles with no toxic effects at less than 1.25 ppm. Physiologically, the heartrates and lengths decreased as the concentration increased, with visible anatomical effects including edema, necrosis of the intestines and liver, and anemia. A t-test revealed the hatchling heartrates of the 1.25, 2.5, and 5.0 ppm to be very highly significant with $p < .001$. The data for .625 ppm was not significant ($p > 0.1$). Mid-metamorphic heartrates were very highly significant ($p < .001$) in all solutions. Mid-metamorphic lengths were not significant ($p > 0.1$) in .625, 1.25, and 2.5 ppm with 5.0 ppm being significant ($p < .05$). Histologically, the low concentrations tested revealed no anatomical effects.

Thus, this three year study demonstrates the use of the *Xenous laevis* indicator system to be a valuable diagnostic tool for the determination of the toxic effects of various chemicals in the environment without depleting other natural frog populations.

#Second Award - General Motors ISEF
Second Award - United States Air Force

MERCURY: OMNIPRESENT POISON

Walton, Wendy C., Long Beach High School, Long Beach, MS 39560;
121 Oak View Avenue, Long Beach, MS 39560.

The purpose of this three-year investigation was to determine if mercury compounds significantly affect living organisms, and to what degree these organisms are afected.

The first phase of research dealt with detecting mercury vapors given off by common household items, using palladium chloride as an indicator.

The second phase dealt with the denaturing effect that mercury has on the enzyme catalase in *Saccharomyces cerevisiae*. A separate experiment was performed to determine the effects of serial dilutions from 1% mercuric chloride on *Lathyrus hirsutus* and *Drosophylia malanogaster*.

The third phase was an attempt to utilize natural absorbants, specifically *Lemna minor*, in treatment pools for factories and plants that have wastes containing mercury or any heavy metal poisons. Atomic absorption tests determined the absorption abilities of the duckweed.

# LIMITING POND WATER EVAPORATION

Fletcher, Laura M., A&M Consolidated H.S., College Station, TX 77840;
9007 Sandstone Drive, College Station, TX 77840.

In many parts of the world, ponds are vital for water storage. Surface evaporation, particularly during the hot summer months, is a serious problem. The purpose of this project is to test a number of methods of limiting pond water evaporation and to determine which is most effective.

A total of nine different surface treatments were tested for their ability to reduce evaporation. These included chemical, physical, and biological treatments: dodecanol, hexadecanol, octadecanol, corn oil; clear bubble plastic, black plastic, styrofoam beads; common duckweed, and algae. These treatments were applied to the surface of the water in thirty 1000 ml beakers, and water evaporation was measured at three-day intervals for 24 days. Final volume measurements were taken on the last day, and these measurements were compared to those for the control set of untreated beakers. Temperature, humidity, and oxygen content readings were also recorded during the test period. This experiment was then repeated a second time.

The results of these tests show that pond water evaporation can be limited significantly by physical and chemical means. Physical treatments, particularly covers, were most effective, providing 25-75% evaporation reduction over the control group. Chemical treatments were also effective, particularly oil (over 70% reduction). The other chemical treatments yielded savings of 5-19%. Biological treatments, on the other hand, increased evaporation.

These findings are a promising step in the solution to the critical problem of water conservation through limiting surface evaporation from small bodies of water.

#Second Award - Marine Technology Society/U.S. Naval Institute

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#THE BEHAVIORAL EFFECTS OF SIMULATED ACID PRECIPITATION ON *DUGESIA DOROTOCEPHALA*: A SECOND YEAR STUDY

Zenk, Brenda M., Henry Sibley H.S., West St. Paul, MN 55118
1184 60th Street West, Inver Grove Heights, MN 55075

Increased acidity poses a threat to life in lakes and streams in northern Minnesota as well as other parts of the world. This study sought to establish a direct positive relationship between increased acidity and increased fission, regeneration, and response to stimuli. A type of planaria, *Dugesia dorotocephala*, was chosen for study because of its position in the food web, its susceptability to acid precipitation, and the ease with which it could be studied. Using various concentrations of sulfuric acid to simulate acid precipitation, planaria were found to die at a pH between 5.0 and 5.5, levels just lower than the levels measured in the waters of northern Minnesota during the summer of 1985. Light sensativity, fission, crawling, nosing-up, and feeding behaviors were studied at pH levels of 7.0, 6.5, 5.9, and 5.5. No absolute correlation was found between pH level and any of these behaviors except nosing-up, a food searching behavior. The greatest nosing-up activity occurred at pH 6.5. In a second part of the experiment, planaria put in a Y-trough were able to choose one of two pH levels. These tests indicated that planaria preferred a pH of 6.5 under these circumstances. There could be some correlation between the increased number of nose-ups at pH 6.5 and planaria choosing pH 6.5, but more tests are needed to support the idea.

#Fourth Award - General Motors ISEF

* THE EFFECTS OF PARAQUAT TOXICITY ON *ORYZIAS LATIPES* EMBRYOS

Sparling, Jennifer K., Detroit Country Day School, Birmingham,
MI 48010;
1925 Lochaven, Union Lake, MI 48085.

Like many other chemicals, the herbicide, paraquat, finds its way into the aquatic ecosystem through aerial spraying and run-off. Despite the manufacturer's claim that paraquat is "environmentally safe," it is important to determine the toxic effects of paraquat on non-target aquatic organisms.

Paraquat is subject to photochemical degradation in the presence of sunlight. Therefore, it does not remain in the environment or an organism for an extended length of time, but exposure during developmental processes can cause serious damage. Small concentrations of insecticides and other herbicides have been shown to cause cardiovascular damage and other abnormalities in fish. It is reasonable to assume that paraquat will act in a similar manner.

Oryzias latipes (The Japanese Medaka) was chosen to test this hypothesis because the species has exceptional clarity of embryonic development.

Three concentrations of paraquat were tested: 2ppm, 1ppm-recommended dosage, and .5ppm-EPA maximum level of contamination in foodstuffs. Eggs were collected each morning and placed in the appropriate concentrations. Controls were also used.

Small concentrations of paraquat did, in fact, cause developmental arrest or serious abnormalities in *Oryzias latipes* embryos. The primary site of action in the embryos was the cardiovascular system, although many other abnormalities were observed.

Environmental studies with herbicides are lacking. For example, we know little about the effects of herbicides combined with other pollutants. Presently, paraquat contamination may not be serious, but it is possible that paraquat will pose a problem for the future.

*First Award - American Society of Agronomy
Third Award - General Motors ISEF

NITROGEN-LIMITED EUTROPHICATION AND BLUE-GREEN ALGAL DOMINANCE OF LAKE CATHERINE: A FOURTH YEAR STUDY

Godwin, Russell D., Lakeside H.S., Hot Springs, AR 71901;
1552 Shady Grove Rd., Hot Springs, AR 71901

This project is the culmination of research conducted on Lake Catherine (near Hot Springs, Arkansas) for the past four years. Research the first two years was focused on the biological aspects of the lake, while last year the research was chemically oriented. This year's emphasis was overall biological and chemical quantitative analysis.

HYPOTHESIS: Lake Catherine is eutrophic with nitrogen limitation, and blue-green algae are the dominant algae in the lake.

METHODS: Water samples were collected at five sites along the shore of the lake. Using a Hach Colorimeter, the levels of ammonia-nitrogen (AN), nitrate-nitrogen (NN), and phosphorus (P) were determined. The dissolved oxygen (DO) level was determined with a Hach Water Ecology Kit, while the pH was determined with a pH meter. The number of green and blue-green algae was determined with a Bausch and Lomb microscope.

RESULTS: All data, except DO levels, support the hypothesis. The NN/P ratio has dropped over the past two years from 3:1 to 1.2:1, while the green algal count has risen over the past four years from 10 cells/mL to 66 cells/mL. These facts indicate that the overall water quality of Lake Catherine has been and is continuing to deteriorate.

CONCLUSION: To offset the deterioration of Lake Catherine, the codes prohibiting the dumping of raw or partially-treated sewage into the lake should be strictly enforced. If this is done, it could greatly decelerate the eutrophication of the lake and increase its overall water quality.

# THE EFFECTS OF TIDAL CURRENT ON THE FACTORS CONTROLLING PRIMARY PRODUCTION: PHYTOPLANKTON OXYGEN PRODUCTION

Ramus, Joshua S., Bainbridge High School, Bainbridge Island, WA 98110
10595 Battle Point Drive NE, Bainbridge Island, WA 98110

The purpose of this experiment was to study the effects of tidal currents on the rate of oxygen production by phytoplankton at varying water depths. More directly, the effect of current on the factors of temperature, visibility, and pH, all of which have been shown to contribute significantly to primary production of oxygen, was investigated.

Using the Light and Dark Bottle Technique with bottles suspended in five-foot increments to a depth of 30 feet, four separate locations were utilized, two of which represented weak tidal currents (<=0.6 knots) and two strong currents (>=2.8 <=4.0 knots). The Classical Winkler Assay was employed to differentiate oxygen concentrations as a function of tidal strength and water depth. Results indicated that, irrespective of water sample depth, as tidal flow increased, visibility, temperature, and pH all invariably decreased. Further, analysis of the gross primary production rate obtained from the four sites indicates an inverse dependent relationship between primary production of oxygen and tidal flow: weaker currents showed more substantial concentrations of oxygen than did stronger ones. In that this study revealed significant correlations between water current and visibility, temperature, and pH, and since these in turn control oxygen production by phytoplankton, it may be postulated that a change in water flow will yield a change in gross primary production.

The significance of these results is that further study of the effect of current on the factors which control primary production may reveal economic significance. Since phytoplankton are the first organisms in the food chain, investigation of the factors most conducive to their growth and production may yield important information regarding areas most hospitable to higher forms of biological life which depend upon phytoplankton for survival.

#Scholarship - United States Navy/NORDA
Alternate to LIYSF Trip - United States Navy/NORDA
Third Award - Sigma Xi, the Scientific Research Society

COMPARISONS OF VARIOUS HARMFUL CHEMICALS IN THE ATMOSPHERE

Foster, Philip H., Emma Sansom High School, Gadsden, Ala. 35904
1411 Monte Vista Drive, Gadsden, Alabama 35901

My project is based upon making a close study and observation of the hazardous chemicals which are in our air. These chemicals contribute to the problems of air pollution. After making an in depth study of the air pollution problems, I decided to measure and compare the amounts of certain chemicals that are frequently detected in the atmosphere. I conducted the experiment in several different areas of Etowah County and recorded my results for a comparison of them. After collecting a variety of samples which detected microgram quantities of chemical elements, I was able to determine which geographical areas had larger or smaller amounts of the hazardous chemicals. Through research and experimentation, I am capable of determining the amounts of chemicals in our atmosphere that may be hazardous to our health.

#THE SYSTEMATIC DEVELOPMENT OF A PORTABLE APPARATUS FOR ANALYSIS OF ATMOSPHERIC CARBON MONOXIDE

Hooker, Brian C., Benjamin E. Mays High/Academy, Atlanta, GA 30331;
653 Peeples St., S.W., Atlanta, GA 30310

Despite various governmental actions, carbon monoxide remains among the major pollutants of our atmosphere. This project is designed to determine whether or not dangerous CO levels exist within the city of Atlanta. It was hypothesized that a device could be developed to measure atmospheric CO levels, and that excessive CO levels exist within the city of Atlanta.

The design of the apparatus was based on the reaction between CO and iodine pentoxide (iodic acid anhydride). Several stipulations regarding this reaction play important roles in the final design. These requirements are that the air must be dried, purified, and maintained at a temperature above 150^{o}C. The former stipulations were met by incorporating a drying tube and a flask of sulfuric acid into the system. The latter stipulation required the engineering of a furnace to maintain the desired temperature. The furnace consisted of a glass tube, wire, insulation, and a d. c. power source. When all stipulations are met, the reaction produces one mole of iodine gas per five moles of CO. The iodine gas is then measured using conventional iodometry.

Construction was based on the above designs, and the device was calibrated using CO and air cylinders. Afterwards, it was taken to twenty different test sites around the city, where CO levels were obtained and compared to EPA standards. The final result was that the device is an efficient, effective means of measuring CO levels, and that harmful levels were rarely found within the city of Atlanta.

#First Award - United States Navy/Office of Naval Research
Alternate to Scholarship - United States Marine Corps
Third Award - General Motors ISEF

PURPLE SULFIDE BACTERIA (THIORHODACEAE) IN THE GREAT SALT LAKE, UTAH

Holloway, JoAnn M., Granger H.S., Salt Lake City, UT 84119
3700 S. Market St., Salt Lake City, UT 84119

Following the recent dilution of the Great Salt Lake, a pink coloration of the brine was noted in the transition layer of the lake's south arm in May, 1985. The biological agent identified as being responsible for this coloration has been identified as Thiorhodaceae, or purple sulfide bacteria. Purple sulfide bacteria has been identified in other environments, such as meromictic lakes, saline lagoons, and sands of tropical beaches. Literature research has shown that the bacteria has not previously been identified in a hypersaline environment such as the Great Salt Lake.

The environmental conditions present in the south arm were correlated and compared to those conditions recorded in previous studies of the bacteria in its other environments to understand the presence of purple sulfide bacteria in the Great Salt Lake. The parameters studied include sulfide and oxygen content, light intensity, pH, and temperature.

As a result of this study, it has been determined that the bacteria inhabit an anaerobic zone where there is low light penetration and the temperature is within a few degrees of that previously recorded as being optimal for growth (20 degrees Celsius). The purple sulfide bacteria are found within a certain range of sulfide concentration (6.5 to nearly 20 ppm sulfide). These conditions allow the existance of the purple sulfide bacteria in the south arm of the Great Salt Lake.

THE USE OF MICROCOSMS TO MIMIC A SEAGRASS COMMUNITY CONTAMINATED WITH COAL DUST

May, Sara K., Titusville H.S., Titusville, FL 32780
101 May Drive, Titusville, FL 32780.

The purpose of this project was to study the environmental impacts that could arise from the operation of a coal fired power plant located on the Indian River. The study consisted of the establishment of a microcosm that simulated a typical seagrass community contaminated with coal dust.

Sixteen 80 liter glass aquariums were filled with ocean water of 22 ppt salinity. Each vessel contained 6 centimeters of washed ocean sand with 10 grams of transplanted sprigs of shoal grass. Three species of invertebrates selected for the study represented different trophic levels within the seagrass communities and were: the isopod, Erichsonella attenuata, the grass shrimp, Palaemonetes pugio and the lugworm Arenicola cristata. Five specimens of each species were placed in the aquariums. Various concentrations of coal dust were subjected to each tank. Controls were left free of contamination.

Six tests were run for periods of time ranging from 13 days to 150 days. In one 13 day test, varying concentrations of antracite coal dust were used. A similar 13 day test was run using bituminous coal. A 13 day test was run using various concentrations of bituminous coal and elevated water temperature. A 35 day test using bituminous coal was run to study long term effects. Tests were run for 150 days to study PH change and coal dust dissipation due to lugworm burrowing.

Results show that nearby seagrass communities could be impacted by coal dust concentrations as low as 0.062 g/l, which could occur within one year of operation.

#First Award - General Motors ISEF
First Award - United States Department of Energy

An Analysis of Water-soluble Internal Combustion Emissions and Their Effects on Bacteria of the Human Respiratory System

Kobe, Jeff, Munster H.S., Munster, IN 46321;
9525 Dogwood Dr., Munster, IN 46321.

A multitude of fuels are readily available, and the exhaust produced by these fuels contain a large variety of water-soluble substances that can be readily assimilated into the human respiratory system and affect the bacteria that are normally present. Emissions from automobiles using different fuels were bubbled through sterile distilled water for two minutes in order to determine what substances were water-soluble. These solutions were then analyzed with an ion chromatograph to determine what the water-soluble emissions were. The fuels used were leaded gasoline, unleaded gasoline, premium gasoline, and the gasahol equivalents of each. A medium, tryptic soy broth, was prepared by using the water saturated with the emission samples. Several different bacteria commonly found on the mucous membrane of the human respiratory system were grown in this medium. The bacterial growth was then monitored by measuring the percent of monochromatic light (525 nm) transmitted through tryptic soy broth in a spectrophotometer to determine the effects of various substances found in the emissions on the bacteria: namely fluoride, chloride, nitrate, nitrite, and sulfate. Although nitrates and sulphates seem to enhance bacterial growth, their presence in the emissions coincided with a rather low pH. It appears that a low pH has detrimental effects on bacteria. However, a presence of ions contributing to a low pH (sulfate and nitrate) is an added detriment to the bacteria. Also, chloride was found to have deleterious effects on bacteria. Those fuels having a low pH or high nitrates or sulfates were leaded and unleaded gasolines, the two most detrimental fuels. It can therefore be concluded that certain automobile fuels are more deleterious to the human respiratory system than others.

#MODEL STUDIES OF RESPIRATORY TRACT DEPOSITION OF ENVIRONMENTAL POLLUTANTS

Cuddihy, Debbie; St. Pius X H.S., Albuquerque, NM 87110
7511 La Madera NE, Albuquerque, NM 87109

The hypothesis of this study is that inhaled smoke particles are deposited in lung airways in non-uniform patterns and concentrate heaviest in airways where lung cancers most frequently occur: the first four bronchial airway generations.

A clear plastic model of the lung airways was constructed. Cigarette smoke was drawn through the model. Some airways were lined with clear plastic adhesive tape to collect the deposited smoke particles. Smoke flow patterns were observed and deposition patterns were observed in the clear model. Sample tapes were removed from the model airways and measurements of the optical density were used to calculate the deposited particles.

The highest deposition of inhaled smoke particles occurred in the mouth, which probably contributes to oral cancer. However, incidence of this type of cancer is low due to the high clearance rates in this area. Deposition patterns of smoke particles in conducting airways were more uniform than expected, being highest in the upper airways and gradually decreasing throughout subsequent airway generations. The deposition was not found to be greatest in the airways where most human cancers occur (first four airway generations). The observed cancer pattern may be due to: (a) the upward clearance of particles deposited throughout the respiratory tract, (b) concurrent damage to the epithelial cells along with cigarette smoke, or (c) greater sensitivity of cells in the major bronchi epithelium where most human lung cancers occur.

#Fourth Award - General Motors ISEF

#WHAT ARE THE MUTAGENIC EFFECTS OF POLYCHLORINATED BIPHENYLS ON DROSOPHILA MELANOGASTER?

Sewell, Kash, South Jr. High School, Henderson, Ky. 42420;
222 Washington St., Henderson, Ky. 42420.

The purpose of this research is to investigate the presence of any mutagenic agents in polychlorinated biphenyls (PCB) as expressed through the *Drosophila melanogaster* organism and its life cycle.

The issue of the presence of PCB's in the environment is a controversial issue in Henderson County because a PCB removal plant is being located in this county. Therefore, many questions have evolved about the potential effects of this chemical in the community of Henderson and the surrounding counties in Indiana, Kentucky and Illinois.

Twenty-two vials of fruitflies were raised. Seven out of the twenty-two were the control group. Fifteen out of the twenty-two were the variable group. Seven out of the variable group contained one gram of PCB's. The remaining eight vials of the variable group were divided into 2's to make up four groups. The first group contained .01 grams of PCB's; the second .25 grams of PCB's; the third .5 grams of PCB's; and the fourth .75 grams of PCB's.

No mutagenic effects occurred in the first group because all of the flies in the PCB's died in the pupa stage. The flies in the control group completed their life cycle normally. In the second part of the experiment mutations were found at various levels of PCB's in the third and fourth generations of flies.

In conclusion, PCB's were found to affect both the organism itself as well as its life cycle. In some cases the PCB's did not allow the fruitfly to develop from the pupal stage and the PCB's did cause some mutations in the third and fourth generations of *D. melanogaster*.

#Fourth Award - General Motors ISEF

#CAN EICHHORNIA CRASSIPES BE EFFECTIVE AS A METHOD OF WATER TREATMENT BY REMOVING LEAD, CHROMIUM, AND COPPER?

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The use of Eichhornia crassipes, commonly known as water hyacinths, has in recent years, become a topic of serious interest to scientists and engineers. Since industries continue to use and dump chemicals, which can collect in lakes and streams, it is important to control the amounts of toxic and heavy metals affecting nature and wildlife. With the possibility of using water hyacinths, it is necessary to determine the maximum levels of metals and wastes that hyacinths are capable of absorbing. If research and current experimentation show water hyacinths as effective control agents, then the potential of water hyacinth treatment will become a reality. The following study has been conducted to ascertain the applicability of hyacinth-based treatment on current water pollution issues.

The experiments performed were designed to determine the ability of water hyacinths to remove lead, chromium and copper ions from the solution. The plants were exposed to selected concentrations of each of these metals and samples were taken periodically throughout a 72-hour period. The results show that hyacinths are capable of absorbing significant amounts of these heavy metal ions in a relatively short period of time. After the first hour of exposure, the water hyacinths removed 73.1 percent of the lead ions, 68.3 percent of the chromium ions and 68.7 percent of the copper ions. It is concluded that the water hyacinths are capable of removing these heavy metals and could be applied for use in water pollution control.

#Second Award - Water Pollution Control Federation

#THE POTENTIAL IMPACTS OF ACIDIC DEPOSITION ON THE LEPOMIS MACROCHIRUS: A PHYSIOLOGICAL AND MORPHOLOGICAL ANALYSIS

Ernst, Todd M., Wayland H.S., Wayland, MI 49348
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A great deal of interest has recently arisen concerning the environmental impacts associated with increasing acidification of surface waters, particularly related to acidic deposition. My project identifies a number of acid induced stresses on specific body functions of the freshwater Bluegill (lepomis-macrochirus). In this study test organisms have been continuously exposed to a sublethal pH level, to determine limits of tolerance of the blood, liver and stomach. However, they do not fully represent conditions a species may experience in the wild.

Samples of blood and these specific organs were collected every weekend from three fish, in a one month period, from both the experimental and control aquariums. The organs were then weighed, dehydrated and prepared for sectioning with a rotary microtome. The changes in blood pH resulted from exposure to the concentrations of acidity. The disturbance of normal blood pH balance resulted in changes in liver weight and composition. The consumption of food tainted in an acidic environment, directly effected the structure of the epithelium of the stomach. Throughout the experiment, bacteria and fungus populations were monitored, as well as water chemistry to verify that high concentrations of acidity was in fact the cause of these results.

So far there is not an available cure for this pollutant. There are however, ways to counteract its effects, but these prove to be too expensive and are only temporary. If we wish to harness acidic deposition we must stop it at the source.

#First Award - United States Air Force
Third Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

EFFECTS ON NON-TARGET ORGANISMS BY PESTICIDE DRIFT

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The purpose of this project was to show that pesticide drift's effects are very broad including plants, animals and humans.

The hypothesis is that pesticide drift, caused by the unwitting mismanagement of farmers, results in serious health and environmental hazards.

The pesticide chosen to work with in the testing is the herbicide, Glean. Glean is a chloronated hydrocarbon.

Two Spathiphyllums, which are broadleaf houseplants, were sprayed in such a manner to simulate drift as much as possible. Both plants died within one week of the initial spraying.

Chickens were also used in the testing. Their feed was also sprayed to simulate natural drift. The feed was then fed to four chickens. Eggs were collected from these four chickens before the test period as well as during. Eggs were also collected from the remainder of the flock during the test period. The eggshells were prepared into a powdered form and dissolved in an excess of hydrochloric acid and ethyl alcohol. After boiling this solution indicator was added. The excess acid was titrated to determine the calcium carbonate content of the shell. A high level of sodium hydroxide used in the titration process can be correlated to a high calcium carbonate. The normal shells took approxiamately 11 ml NaOH in the titration while only 2 ml was used on the pesticide shells. This shows there was a sharp decrease in the calcium carbonate level in the pesticide shells. A decrease such as this could be most deterimental to a species.

Fluorescent dye was added to the spray to allow for exposure and distribution of spray testing.

CONTROVERSIAL ISSUE: ARE EPA TOXIC WASTE STANDARDS SAFE?

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Controversial Issue addresses the problem of the use of bio-monitoring techniques in toxic waste management. Determine the effects of the Environmental Protection Agency's "acceptable" concentrations and dilutions thereof of toxic wastes on planaria regeneration & conditioning. Obtain 3 toxic wastes, each from a different toxic waste family: 2,4 Dinitrophenol (herbicides), toluene (solvents), & copper (heavy metals). Prepare the EPA acceptable levels of concentration and 7 successive dilutions thereof for each of these toxins. Add 5 planaria to 25 ml of waste solution in each petri dish. Prepare controls for pH, hardness, and alkalinity. For the regeneration ability tests, cut the planaria in half & record regeneration for 18 days, using a special scale developed for tail regeneration. For the conditioning ability, run conditioning tests every 2 hours for 2 days, using electric shock as the motivation to turn left in a simple T maze. None of the dishes for control of pH, hardness, and alkalinity showed a significant deviation from the overall control. After validating with the Chi-square method, conclude that the toxins cause significant impairment of both regenerative and conditioning abilities at the Environmental Protection Agency's "acceptable" levels. The regeneration tests showed inconsistent responses from each different chemical, but the conditioning tests showed a consistent response regardless of the toxin. Planaria conditioning ability is thus a better method of bio-monitoring of toxic wastes than the methods currently being used. It would detect synergisms between different toxins and should therefore be used to verify "acceptable" concentrations of chemicals in a water supply.

#Third Award - General Motors ISEF

#EFFECTS OF TEMPERATURE ON MACROPHAGE ACTIVITY IN SPOT

Head, Kathryn S., Loudoun Valley H.S., Purcellville, VA 22132
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Temperature changes in the Chesapeake Bay due to thermal pollution may raise the susceptibility of finfish to viral, bacterial, and fungal infection due to a decline in immune function. The cellular immune response in fish involves nucleated cells called macrophages, which have the ability to phagocytize foreign material. Abnormalities in immune function can be detected by a lower percent phagocytosis in stressed fish. The estuarine fish, spot, *Leiostomus xanthurus*, utilized in this experiment were captured from the York River--a relatively non-polluted tributary of the bay with no significant industrial development. This species does not adapt readily to environmental changes, yet is abundant in major industrial areas.

After the spot were exposed to temperatures of 4°C, 15°C, and 25°C for five days, the kidneys were dissected under aseptic conditions, and macrophages were separated by Percoll density gradient centrifugation. Macrophages were incubated at 17.5°C after innoculation with *E. coli*, and samples were taken at 30 minute intervals. After 150 minutes, positive phagocytosis in macrophages at 15°C was 75%±7.21%, whereas the value at 25°C was 59%±2.65%, and the value for 4°C was 50%±19.08%. The phagocytic activity was markedly reduced in fish exposed to extreme temperatures as compared to fish in an optimum environment of 15°C.

Prolonged exposure to stressful temperature decreases resistance to disease and may cause striking reduction in resistance of fish to toxic chemicals. Thermal pollution may cause species of fish to become extinct and may impair the health of the Chesapeake Bay by reducing its powers for self purification.

#Third Award - General Motors ISEF

#COTTONWEED (Otanthus maritimus): AN ECOLOGICAL SURVEY WITH A VIEW TO CONSERVATION

Langrell, Stephen, CBS, Gorey, Co Wexford, Ireland
6 West Hill Park, Gorey, Co Wexford, Ireland

On a fringing gravel barrier at Lady's Island Lake, S E Wexford, Ireland, is found the last existing Cottonweed (Otanthus maritimus) station, having become extinct elsewhere in the British Isles. Being of Mediterranean origin and exhibiting a Mediterranean/Atlantic distribution, Cottonweed reaches its most northern extreme at this station. Its unusual distribution has attracted scientists from all over Europe. However, although quite popular among scientific institutions, little was known about its requirements, distribution factors and threats. Also, I believed, conservation proposals and measures by Government environmental bodies were inadequate and detrimental to its continued survival.

I carried out an ecological survey of the area, identifying the habitat characteristics suited to this species and the factors affecting its distribution. Immediate and potential threats were identified and proposals put forward for its proper conservation. Having located all previous reports and additional data, I surveyed the habitat using the belt transect technique. As the stand is very small and the vegetation pattern appears related to the surficial material, two belt transects were taken with the emphasis on substrate/quadrate analysis. I investigated Cottonweed associations with other species present and also its response to the edaphic factors. I concluded Cottonweed survival depends on:

- A distinct characteristic habitat
- its geomorphological and climatological factors
- more informed Government conservation measures to protect the existing station, and, use of the design model for recolonisation of those stations where it has become extinct.

#Third Award - General Motors ISEF

#THE ROAD SALT DILEMMA: SAFETY OR THE ENVIRONMENT?

Gonnion, Jason F., Beaver Dam Junior High School, Beaver Dam, WI 53916
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This experiment is designed to measure the environmental impact of salt when used as a road deicer in northern states. Laboratory tests were run to quantify the effects of commonly used concentrations of salt on roadside vegetation and rate of infiltration into groundwater. The results are of great importance to municipalities which use and stockpile salt for use on streets and highways.

Five separate experiments were run: 1) Percolation rates for common soil types were determined by timing water filtration in capillary tubes containing soils representing a variety of particle sizes. Salt contamination of groundwater was shown to be more likely in areas with 'sandy' soils, as increased particle size showed increased percolation rates. 2) Using a 300 lb/highway mile concentration, salinity contamination rates were determined for different watertable depths. Results show that shallow watertables run a greater risk of contamination. 3) While maintaining a constant watertable depth, three common salt-spread amounts were applied in solution atop surface soils. Salinity of groundwater was measured, showing that increased salt usage produces a proportionate increase in groundwater salinity. 4) To quantify the impact of salt on roadside vegetation, grass plants were exposed to the three common salt-spread amounts and their growth rates measured. Results show a significant reduction in growth rates the greater the amount of salt used. 5) To test distance from roadbed and the effects of salt, trays of grass plants were angled to simulate drainage from highways and three salt-spread concentrations applied. Growth rate measurments show the stunting effect of salt greatest near the roadway and with increased salt usage.

In summary, this experiment demonstrates that salt, when used as a road deicer, may produce groundwater contamination depending upon the depth of the watertable, type of soil, amount of salt used, and frequency of application. Roadside vegetation is also adversely affected by salt application. The alternatives to the use of salt would be to find other methods of deicing, or reduce concentrations and frequency of application.

#Third Award - National Water Well Association

#A COMPREHENSIVE LIMNOLOGICAL STUDY OF THE TROPICAL LAKE "SANTUARIO DE AVES" IN BARRANQUITAS, PUERTO RICO

Ortiz-Zayas, Jorge R., Barranquitas H. S., Barranquitas, P. R. 00618, Bda. La Vega #40-A, Barranquitas, P. R. 00618

Chemical, physical, and biological determinations were conducted at two small tropical lakes in Barranquitas, central Puerto Rico. The work was part of the second phase of a study conducted to determine the effects of wastes from a rookery of cattle egrets (Bubulcus ibis) located at one of the lakes. Lake Santuario de Aves, where the rookery is located, was used as the experimental lake and compared to a nearby lake. Samples were collected and determinations were made over a 6-month period. The effects of the rookery on the experimental lake were evident from the concentrations of nutrients, bacteria population, and dissolved oxygen. Higher ammonia, organic nitrogen, nitrates, and phosphorus occurred at the experimental lake. Fecal coliform to fecal streptocci bacteria ratios indicate the fecal wastes possibly of animal origin contaminate the experimental lake. The number of phytoplankton cells at the experimental lake were greater than in the control lake (28,000 against 21,400 cells/mL). Productivity tests at the experimental lake indicated a balanced system (P/R=1.1). Dissolved oxygen concentrations averaged 6.6 mg/L. The effects of runoff from a rainstorm on both lakes were also studied. The concentration of nutrients and dissolved solids increased significantly after the strom. The Sechi Disk tramsparency was reduced from 80 to 8 cm. The pH value, which were significantly different between the two lakes (7.8 in the experimental and 8.6 in the controlled) increased after the storm. There was not any significant temperature stratification in both lakes. The investigation suggests that the rookery may be contributing significant nutrient loads to the lake. However, runoff contributions are equally important.

#Fourth Award - General Motors ISEF

#PHYSIOLOGICAL AND ANATOMICAL ALTERATIONS PRODUCED BY COMMON POLLUTANTS: COMPARATIVE STUDY OF MARINE PLANTS FROM THE SHALLOW WATERS OF P.R.

Santana, Angel E., Dr. Pedro Perea Fajardo H.S., Mayaguez, PR 00709;
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Thalassia testudinum Koenig or turtle grass and *Syringodinium filiforme* Kuetzing are marine angiosperms that with various associated species, form a characteristic assemblage, known as turtle grass meadows, on sandy and muddy bottoms. Although *Thalassia* is the dominant marine grass in Puerto Rico, other marine plants, the algae are also found in the meadows. Among these we find *Ulva*, *Valonia*, *Dyctiota*, *Sargassum*, *Caulerpa* and *Padina*. This investigation is an attempt to consider some aspects of the ecology of these plants on island waters emphasizing the effects of pollution on these plants and postulating the use of the large biomass, made up mainly of these plants, that the sea puts ashore daily, as a possible source of energy.

Nine stations were selected along the southwestern coast of the island. The environmental parameters affecting these plants were determined. A chemical analysis of the plants in each station was carried out to determine water, organic matter and mineral content. The same was done for the substrate. The growth of *Thalassia* in each station was measured as well as percentage of browsing.

To determined the effect of contaminants such as urea, DDT, Gasoil, Rins and Vel on the plants, the organisms were subjected to concentrations of 1%, .1%, .01%, .001% and fresh sea water as a control. The effect of the pollutants was determined by checking the liberation of O_2 bubbles as the plants were allowed to carry on photosynthesis.

Photosynthetic pigments, chemical composition and internal anatomy of plants were also analyzed for the plants exposed to the different concentrations to determine these effect.

A determination of how many tons of biomass per acre are produced at each station was carried out. Amount of biomass thrown by the sea on one station was calculated. Amount of methane gas produced by this biomass through fermentation was calculated and a good yield was obtained.

#Fourth Award - General Motors ISEF

MATHEMATICS

#NEW RESULTS IN NUMBER THEORY

Hung, Oliver L., Baton Rouge H.S., B.R., LA 70806
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This project is divided into three sections. The first section deals with the topic of primality testing and factorization, exploring new means of testing and factorization. The second section deals with the Pythagorean Theorem and discusses the role of primes and "relative" primes in considering Pythagorean problems. The final section of this project deals with a new Binomial Theorem, based upon the properties of m^n variables. In this project, new results and advances were obtained in the areas of number theory.

#First Award - United States Army

A NEW ERATOSTHENES SIEVE

Brookwell, Antony, Fort Collins H.S., Fort Collins, CO 80524;
223 Scott Avenue, Fort Collins, CO 80521.

No exhibit.

HOW HIGH CAN A ROCKET GO STATISTICALLY ?

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Batesville, In. 47006 Osgood, In. 47037

I was always intrigued with how high a model rocket could go and was curious to see if the altitude could be determined.

Hypothesis: The actual altitude of a model rocket can be determined by using various mathematical formulas.

Purpose: I wanted to determine the theoretical and actual altitude of a model rocket while accounting for temperature variations and atmospheric density.

Procedure: By using the following formulas I was able to determine the theoretical altitude at various intervals that a rocket would attain

1.) velocity change in interval $v = (\frac{F-D}{w} - 1) 32t'$
2.) velocity at end of intervak $v = v'' + v'$
3.) altitude added in interval $H = (\frac{V'' + V}{2}) t'$
4.) Altitude at end of interval $H = H'' + H'$
5.) Drag at end of interval $D = .00007413 V^2$
6.) Theoretical velocity $V_T = V_T'' + \left(\frac{F-1}{w}\right) 32t$
7.) theoretical altitude $H_T = H_T'' + (V_T'' + V_T) t'$

The theoretical rocket height was then compared to the actual rocket height with and without wind resistance.

Results: The altitudet tracker showed my equations were correct with a possible deviation of ± 15 feet due to air density changes at different altitudes. I was able to come within 3 feet of my theoretical measurement, the drag had to be accounted for because of the air resistance. This amounted to 457.2 feet.

Conclusion: The altitude of a model rocket can be determined mathematically.

#PROBABILITY MATRICES

Scott, Daryl A., Pine View High School, St. George, UT 84770;
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The ultimate goal of my study in matrix probabilities is to: set forth and use a system for making probability studies using matrices and to show that this process works by solving the problem: WHAT IS THE CHANCE, OR PROBABILITY, OF A PLAYER BEING ON ANY GIVEN SQUARE AT ANY GIVEN TIME DURING A GAME OF MONOPOLY. Monopoly was selected for this study because of its intricacy and its use of both dice and cards for movement. In this study I first found the probability and outcomes of rolling dice through a 6 X 6 matrix. Card probabilities were then determined using two 1 X 15 matrices. The two tables generated by dice and card probabilities were used to make the original 41 x 41 matrix consisting of the probabilities of traveling from every square to every other square in one turn. This matrix was then raised to the 35th power by multiplying every column in the original matrix by every row in the original matrix 35 times. This process generated a constant probability matrix where all column entries are equal. From this final matrix I then extracted the final probability table. These results can then be used in the formulation of advanced data tables which may be used in Monopoly game strategies. The process developed will work, completely or in part, for other board games based on chance.

Summer Scholarship Award - Ohio State University
Fourth Award - General Motors ISEF

THE TWO-DIMENSIONAL GEOMETRIC DISTRIBUTION OF PRIME NUMBERS: A THREE YEAR STUDY

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The purpose of this study was to investigate the geometric distribution of prime numbers in relation to the number system. It was hypothesized that the primes would display geometric regularity when put in a square spiral graph. A program was written to display the primes in a square spiral beginning with forty-one (41). (This demonstrated Euler's formula: N^2+N+41.) It was found that a diagonal crossing the entire screen was generated. Then a random spiral of the odds was plotted as a control and no significant diagonals appeared. After the prime patterns were observed, it was conjectured that prime twins also formed patterns. This was investigated. Next several Euler-type formulas: N^2+N+M were developed that generated large numbers of primes. The square spiral patterns were utilized to display and study the results of these formulas, specifically what percentage of the primes are produced by them. Finally, it was concluded that: (1) Prime numbers do display order in the number system. (2) Prime twins do not produce patterns. (3) Lower prime twins usually generate large amounts of primes when substituted in an Euler-type formula. (4) Over determination of the primes is displayed by utilization of Euler-type formulas. This research can be applied to cryptography (the study of coding) which has both commercial and military uses and also to the solving of algebraic polynomials.

#IT'S NOT CARTESIAN: A STUDY OF A NEW GRAPHING SYSTEM

Finger, Christopher C.,
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Graphing equations is the basis for most mathematical work. Most graphs are constructed using the Cartesian coordinate system where each ordered pair defines a point. I have created the Triangle system where each ordered pair defines a segment joining the axes.

My research included studying the slopes of segments, conic sections, and inverse equations; solving simultaneous equations; and determining when segments cross. I defined the slope of a segment as if it were a Cartesian line and proceeded to study the slopes of various equations. I found formulas, much like those used in differential calculus, for finding slopes of various equations. After discovering that the slope of any segment is $-y/x$, I proved these formulas and discovered that any segment's slope is negative in the first and third quadrants and positive in the second and fourth.

The study of the conic sections showed that the circle and ellipse, enclosed figures in the Cartesian system, have crossing segments that form curves while the parabola and hyperbola, not enclosed in the Cartesian system, do not. I found that for any equation, its segments cross if its slope in the Triangle system and its first derivative are either both positive or both negative.

My study turned up two flaws in the new system. First, any segment with one coordinate being zero cannot be seen since it lies on an axis. Secondly, a step between x values must be specified, for if the step is infinite, single segments cannot be discerned.

Other attributes of the system are discussed in the project research paper.

#First Award - United States Air Force
Summer Scholarship Award - Ohio State University
Third Award - General Motors ISEF

#IT ALL ADDS UP

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The goal of this project was to find the best formula for the sum of the xth powers of the first n positive integers, or:

$$S_x(n) = 1^x + 2^x + 3^x + . . . + n^x$$

This independent research produced six unique solutions. Each solution began with an idea which became a workable approach toward the problem. These approaches were then pursued and developed into solutions. The best method was then determined by selecting the simplest solution with the shortest proof.

The names given to the six solutions found in order of discovery were the Substitution Method, the Matrix Method, the Increment Method, the Binomial Method, the "Series of a Series" Method, and the Reduction Method The Matrix and Reduction Methods produced non-recursive formula was concise and useful, and its proof was short.

Conciseness and the beauty of the solution made the Reduction Method the highlight of this project. An outstanding feature of this method was that the nth term could be any polynomial of a constant integral degree.

#Summer Scholarship Award - Ohio State University
Second Award - General Motors ISEF

#FERMAT'S LAST THEOREM $A^n + B^n \neq C^n$ FOR $n > 2$ WHERE A, B, C & n ARE INTEGERS

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Pierre de Fermat, 1601-1665, wrote that he had a remarkable proof of $A^n + B^n \neq C^n$ for $n > 2$ where A, B, C and n are positive integers, but he did not present the proof. This proof was never found in his notes, papers or anywhere. In 1983 Gerd Faltings, a German, presented a 40 page proof that there exist only a finite number of primitive solutions for any $n > 2$. Critics called his proof masterful.

The purpose of this project was twofold: (1) to develop special case proof(s) i.e., n=3, and (2) to develop a general case proof (n>2) if possible. I have achieved both of these objectives. I have developed a general proof, which I am submitting to mathematicians for verification.

My contribution is a system of theroems the apex of which is Theorem IV. My method of proof is use of infinite ascent which is made possible by Faltings theorem. My theorem IV (Chain Law) says that if one or more solutions exists then an infinite number of solutions exist. However, Gerd Faltings proved that there are only a finite number of solutions for $n > 2$. The only way both of these theorems can be satisfied is that there are no solutions when $n > 2$, thus proving Fermat's Last Theorem.

#Fourth Award - General Motors ISEF

FINITE DIFFERENCES

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Finite Differences is an age-old mathematical tool that examines the changes in the functional values of a particular function caused by changes in the independent variable of that function. The basic method relies heavily only on elementary arithmetic calculations and so is ideal in its simplicity and practicality. Using a differencing process between consecutive terms in the functional values, a table of differences was constructed. Investigating the actual differencing process, I found that every term in the table could be rewritten as the finite sum of the terms in the first, original row multiplied by binomial coefficients for the expansion of $(a-b)^m$. Pursuing the investigation further, the individual terms in the original row can also be expressed as a finite sum of the first terms in the original sequence and successive differences multiplied by binomial coefficients for the expansion of $(a+b)^m$:

$$f(x+mh)=mC0f(x) + mC1\Delta f(x) + mC2\Delta^2 f(x) + \cdots + mCm\Delta^m f(x).$$

This last formula leads to many applications. One is a general method for solving equations in one variable, which covers all possible functions, i.e. algebraic and transcendental. Secondly, finite differences can be used to approximate functional values for a known function, and interpolate values for unknown functions. Thirdly, the last formula above can be manipulated to find a general rule for the summation of a numerical series.

Finite differences is a very broad topic and enters into many branches of mathematics. The results obtained here have only touched the tip of a vast, varied, and useful mathematical tool.

A STUDY OF SOAP FILM FORMATIONS WHEN BOUNDED BY TWO PARALLEL PLANES AND ARBITRARY VERTICES

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Soap bubbles inherently minimize surface area as observed in their spherical shape, the sphere being the shape with the smallest amount of surface area that encloses a given volume. In order to see if this held true with soap films, specially designed frames were constructed with two parallel plastic sheets joined by three or four perpendicular rods. These were dipped in a soap solution and the resulting soap formations were observed. Computer simulations were designed and programmed using minimum surface area as a parameter. The simulated formations were identical in shape and proportions to the experimental results. This suggests that soap film formations minimize surface area as do their unbounded spherical counterparts.

It was observed that when three soap films meet, they do so in 120° angles. This phenomenon is not confined to soap film formations; rather, it has been discovered to exist in all formations of minimal distance connecting three or four points. To show this, the Law of Cosines was used in conjunction with the simulations which showed that in all triangular formations with interior angles of less than 120°, the segments meet in 120° angles. In all others, the focus degenerates to one of the vertices.

In conclusion, formations of soap films bounded by two parallel planes and arbitrary vertices minimize surface area. These minimal surface area configurations have a common link: they all include 120° angles. It is hypothesized that all formations of three flat surfaces meeting in 120° angles is the minimum surface area formation for those surfaces.

#AN ORIGINAL METHOD FOR SOLVING TANGENTIAL CIRCLE SYSTEMS

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A problem puzzling mathematicians for over 2000 years is the solution for a 4th tangent circle in a system given the other 3. Earlier solutions required solving quadratic equation systems, a very time consuming process. I have discovered a shorter and more efficient method. I found it is possible to calculate a constant numerator value which is the product of the first two radii divided by the third. When this is properly normalized, all additional circles can be found by sequentially adding to the denominators the sequence (1,3,5,7,.....). This produces all of the tangent circles at one time. In this form it applies only to cases where $r_1 = r_2 + r_3$. The solution set is precisely the values you get when solving by more complicated methods. My method allows the calculation of a simple formula for all denominators in terms of the position n. The specific equation will depend upon the given circle radii.

Examining the general case requires a more rigorous analysis method. M, the constant numerator value is calculated as before. However, a new value D, the second order change in the denominators, can also be calculated by a new equation. This is treated as an acceleration-like value for the denominators, and the method continues to work. Extensive verification was done against existing methods using a specially developed computer program. In addition, a general case was solved using variables and proved the method worked in a general sense.

Dr. Solomon Golomb, Professor of Mathematics and Engineering at the University of Southern California, Los Angeles, reviewed and verified my results.

#First Award - United States Navy/Office of Naval Research
Second Award - General Motors ISEF
Third Award - Mathematical Association of America

GENERALIZED PASCAL'S TRIANGLE

Wu, Peter G. Choctawhatchee H. S. Ft. Walton Bch, Fl. 32548
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For the past century, mathematicians have been amazed at the versatility of a simple array, Pascal's Triangle. The unique properties of Pascal's Triangle used for binomial expansions can be generalized for multinomial expansions. Through hypothesising and proving, I found values for the number of terms in a multinomial expansion as a function of (n) and (t), the exponent and number of variables respectively. The coefficients can be found by the Multinomial Theorem. Then, these coefficients can be arranged into arrays having dimension of (t) and level of (n), called a (tr) array.

The new concepts of this project can be applied in many fields of mathematics. For example, the term cosθ + (i)sinθ or cisθ to a power may be simplied using the Binomial Theorem, consequently yielding values for cos(nθ) and sin (nθ). Using Pascal's Triangle, a probability can be found as a summational value or combinatoric value. Probability distributions can be developed from Pascal's Triangle and applied to subjects such as random walks and the relationship between the (tr) arrays and probability distributions of random walks. Applications in pure mathematics can be developed for finding values for $\sum_{a=1}^{n} a^p$ where (p) and (n) are natural numbers.

*Title: The Scholz-Brauer Conjecture on Addition Chains
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In 1937, A. Scholz asked if the following inequality (which was referred as the Scholz-Brauer conjecture later) held for all positive integer n: $\ell(2^n-1)\leq n-1+\ell(n)$, where $\ell(n)$ is the number of multiplications required to raise x to the nth power.

An addition chain for n of length r is an integer sequence $1=a_0<a_1<a_2<\cdots<a_r=n$, $a_i=a_j+a_k$ for $1\leq i\leq r$, with $0\leq j, k<i$. Then the minimum of the length of all addition chains for n is $\ell(n)$.

Some preliminary results were known: W. Hansen proved $\ell(2^n-1)\leq n-1+\ell^0(n)$ with $\ell^0(n)$ a function may be slightly larger than $\ell(n)$; Gioia, et al showed that the Scholz-Brauer conjecture holds for those n whose binary forms contain three 1's or less. In this project, I refined Hansen's inequality, and extended Gioia's theorem to those n with binary forms containing four 1's. My proofs are constructive, e.g., one may derive efficient computation algorithms from them.

Besides, I proved $\ell(2^n-1)=n-1+\ell(n)+o(\ell(n))$, a result stronger than the respective asymptotic results of P. Erdos and Cottrell:

$$\ell(2^n-1)=n-1+O(n/\ell(n)),$$
$$\ell(2^n-1)\geq n-1+(\log_3 2)\ell(n)+o(\ell(n)).$$

In some sense, it is even better than the Scholz-Brauer conjecture.

*First Award - General Motors ISEF
First Award - Mathematical Association of America
First Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society
Second Award - United States Air Force
Honorable Mention - National Aeronautics and Space Administration

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PROVING FERMAT'S THEOREM
Torres, David, Santa Fe H. S., Santa Fe, NM 87501
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The purpose of the investigation was to attempt to prove a theorum developed and validified by Pierre Fermat without the aid of textbook or supervision: $n^p - n$ is divisible by p where n is a whole number and p is a prime. The procedure began with factoring the expression $n^p - n$ to $n(n^{(p-1)/2} + 1)(n^{(p-1)/2} - 1)$, and then reducing the number of values of n to be tested to less than or equal to the value $(p-1)/2$. Pascal's triangle was then considered and the applications of its coefficients to the theorem.

The proof of the theorem involved the expansion of $(a + b)^x = a^x + xa^{x-1}b/1! + x(x-1)a^{x-2}b^2/2! + x(x-1)(x-2)a^{x-3}b^3/3!+\ldots xab^{x-1} + b^x$.

The proof rested on two facts. First, all middle terms of the expansion have the power as a factor. Secondly, $n^p - n$ can be rewritten to the sum $(1 + (n-1))^p - n$. Since all the middle terms are divisible by x, only the first and last a^x is rewritten as a sum of one in each successive expansion while the a^x term continually generates ones. This process is carried out until $(1 + 1)^x$ results and the last b^x becomes one. This final b^x one added to the accumulated a^x's ones produces a convenient sum of n which is subtracted in the original $n^p - n$. The middle terms remain and these are divisible by the power in question. The dividing coefficients 1!, 2!, 3!...determine why the power must be a prime.

DEVELOPMENT OF A GEOMETRY FOR ANY NUMBER OF COORDINATES

Mendez Torres, Abel; Lino Padron Rivera High School, Vega Baja, P.R.
Box 427B, Vega Baja, P.R. 00764.

The purpose of this research is to develop an analytic geometry for any number of coordinates in the euclidean space. The equations that determinate the n-coordinates system were created at first in base to a generalization of the distance between points formula. The equations were determinated by two different methods: in base to the directory cosines of each coordinate and given the cosines of the angles between each coordinate.

The n-coordinates system were interpreted in different ways: as coordinates with a common origin, traslations and/or rotations between coordinates systems, coordinates as a sum of subcoordinates, a geometric sum of coordinates and as a n-coordinates system where n is a variable or a constant inside the real or imaginary number set.

Various software were created to construct graphics of some figures given their equations and parameters. One of these programs constructs graphics of curves, surfaces and solids in one, two or three dimensions and it also can traslate, rotate and enlarge the figures. This program works in base to a six coordinates system which transforms to three and then to a proyection in the monitor screen plane. Some of the constructed figures are curious curves; surfaces as polygons, the torus and the Moebius strip and solids as the cube.

This n-coordinates geometry has a great utility in the simplification and interpretation of problems about the development of equations that describe complex geometrical figures and it also generalizes the analytic geometry because it can be applied to any number of coordinates in the abstract and physical space.

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*TIME DELAYS IN PREDATOR-PREY SYSTEMS

Arvind Krishnamurthy, Eleanor Roosevelt H.S., Greenbelt, MD 20770;
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The purpose of this study was to examine the effect of the length of a time delay on the stability of a predator-prey system. The predator-prey system is simply a population interaction between two species, one a predator and the other a prey. Unique to this system is the limiting factor each species exerts on the other. Because of this factor the predator and prey populations repeat in a steady cycle. This study determined how a time delay, in the form of a maturation period, would affect the ocurrence of this cyclical pattern. A model consisting of three differential equations was created to demonstrate population changes of each species over time. Unique to the model was the separation of prey into two classes, mature and immature. This separation allowed the system to be completely solved. Using the eigenvalue method for nonlinear systems, solutions of predator and prey populations with respect to time were determined. These solutions were then used to test long and short maturation periods. It was found that large maturation periods destabilized the system so that both populations would approach extinction. Short maturation periods, on the other hand, had no affect on the stability of the system.

*First Award - Sigma Xi, the Scientific Research Society

BASSIMALG: The Result Of A Two-Year Investigation Of The Simplex Algorithm

Brooks, Lee M., Rhame H.S., Rhame ND 58651
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PROBLEM: Solving an allocation problem graphically imposes a limitation of three activities because an axis, and thus a dimension, is assigned to each activity involved. How can a Linear Programming problem with more than three activities be nongraphically solved?
HYPOTHESIS: The Simplex Algorithm, in a graphical sense, moves along adjacent feasible corner-point solutions until the optimal solution is located. Therefore, to solve bigger problems, the Simplex Algorithm has to be implemented by a purely mathematical means. Can a computer program using the Simplex Algorithm be developed to augment the number of possible activities and constraints?
PROCEDURES: The approach used in this project involves the manipulation of a set of linear equations which represent the allocation problem. The data involved in the problem are converted from inequalities to equations by introducing slack variables. The equations are then arranged matrix fashion into a table. An operation called the Pivot Transformation is then applied to the table, which in effect will find a solution (basic feasible corner-point) to the system of equations. The algorithm proceeds from table to table until the optimal solution is located. The variables are labeled in a manner that will allow each table to correspond to a specific feasible corner-point solution. Thus it is possible to determine which point each table represents.
CONCLUSION: BASSIMALG, an acronym for BASIC Simplex Algorithm, is the name of the computer program designed by Lee Brooks. It has proven successful in solving both maximum and minimum type problems. The BASSIMALG solutions to selected test problems are quite accurate. The program can also recognize when a problem is unbounded or infeasible.

#POLYNOMIAL SEQUENCES

Chuang, Neal, Thornton H.S., 9351 N. Wash., Thornton, CO 80229;
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This project outlines the following discoveries of the characteristics of polynomial sequences: First, that for any arithmetic sequence or arithmetic series sequence, it is possible to find a polynomial function that generates that sequence. Second, for any polynomial function, it is possible to generate an arithmetic sequence or arithmetic series sequence from that function. Third, there are predictable characteristics of the differences of sequences generated from polynomial functions. Finally, the following two series yield interesting results:

$$\sum_{i=0}^{m}(-1)^i C_i^m (p+m-i)^m = C_0^m (p+m)^m - C_1^m (p+m-1)^m + C_2^m (p+m-2)^m - C_3^m (p+m-3)^m + \cdots + (-1)^m C_m^m p^m = m!$$

$$\sum_{i=0}^{m}(-1)^i C_i^m (p+m-i)^j = C_0^m (p+m)^j - C_1^m (p+m-1)^j + C_2^m (p+m-2)^j - C_3^m (p+m-3)^j + \cdots + (-1)^m C_m^m p^j = 0$$

where m, j, and p are positive integers or zero and $j \leq m-1$.

#Third Award - General Motors ISEF

BLACKJACK

Chen, William, Auburn H.S, Auburn, AL 36830
1124 Rustic Ridge Rd., Auburn, AL 36830

The purpose of my project was to determine whether it was possible to consistently win money at blackjack, and to write a user-interactive program that a gambler may use. The research that I did showed that there were many systems available. However, the percentage of return on each of the advanced systems were all in the range 1.1% to 1.3%. Thus, I only incorporated Julian Braun's advanced point counting system, which is the easiest to learn. I changed Braun's system to include a side count of aces, and found no appreciable difference. The return on both systems for typical Las Vegas casino rules were both 1.1% with a margin of error around 0.1%. I also ran the basic strategy for blackjack which does not include the counting of cards. The percent return on the basic strategy was -0.1% with a margin of error also 0.1%. The tests were run using a TURBO PASCAL (copyright by Borland International) program with an AT@T 6300, an IBM PC compatible, doing a million simulations. Then I changed my program to become user friendly. I also did some mathematical calculations to determine the probabilities of winning with limited capital. My final conclusion is that it is only possible to win consistently at blackjack if one keeps an accurate count of cards, and disciplined betting. Even so, one can only expect to win at a slow rate.

#A GRAPHICAL APPROACH TO THE 3x + 1 PROBLEM

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The 3x + 1 Problem, first proposed in 1932, is one of the most widely known unsolved problems in modern number theory. The problem defines a function f on the natural numbers x such that if x is even, $f(x) = x/2$; and if x is odd, $f(x) = 3x + 1$. For every initial value of x, it is conjectured that the sequence $f(x)$, $f[f(x)]$, $f(f[f(x)])$, . . . will always eventually yield a value of 1. As an illustration, if the initial value is 12, the sequence formed is: 12, 6, 3, 10, 5, 16, 8, 4, 2, 1, 4, 2, 1, . . . , and the sequence gets stuck in a 4,2,1 loop. The problem is to prove the conjecture. Vast amounts of research time spent on this problem have yielded little new information. According to Paul Erdös, a world-renowned number theorist, "Mathematics is not yet ready for such problems."

This paper presents an entirely new graphical method for studying the 3x + 1 Problem. An encyclopedic survey of the problem in the January, 1985 *American Mathematical Monthly* tells of no similar approaches. The graph developed in this paper is used to determine, with proof, many general properties of the sequence. One such theorem is that the only 3-element loop is a 4,2,1 loop. The paper also discusses properties of non-4,2,1 loops (if such loops exist) and establishes that some initial values of x will require arbitrarily many iterations before entering a 4,2,1 loop. Although this paper does not completely resolve the 3x + 1 Problem, it may lay the groundwork for a complete proof or disproof of the conjecture. Every result presented in the paper is entirely original. The research involved was conducted without assistance.

#London International Youth Science Fortnight - United States Navy/
Office of Naval Research
Second Award - Mathematical Association of America
Fourth Award - General Motors ISEF

A STUDY OF QUASAR, STAR, AND TRIANGULAR NUMBERS IN TWO AND THREE DIMENSIONAL SPACE

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Figurate numbers are positive integers expressing the number of dots in various geometric "Figurate" patterns. In this project, six of these kinds of numbers were studied: Triangular numbers, Star numbers, Quasar numbers, Triangular Pyramidal numbers, Square Pyramidal numbers, and Three Dimensional Star numbers. The first three are associated with two dimensional space, and the latter three with three dimensional space.

The purpose of the project is to define various figurate number types, and to determine a formula for the generation of these kinds of numbers. The formulas are then proved using proof by mathematical induction. Theorems concerning divisibility and closure properties, as well as evenness and oddness patterns are proposed and proved.

This original research was initially conducted on figurate numbers based upon two dimensional plane figures, (Triangular, Star and Quasar numbers). The two dimensional place figures were then extended to three dimensional space, which included author-defined three dimensional figurate numbers (Triangular Pyramidal, Square Pyramidal, and Three Dimensional Star numbers). For completeness, a study of the one dimensional regression of each of the three two-dimensional figures was included. A proposal for further research in relation to four dimensional space and beyond is also included.

#FRACTALS

Baker, Sung M., Bonanza H.S., Las Vegas, NV 89102
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RESEARCH: In 1950, an eccentric mathematician named Benoit B. Mandelbrot transformed chaotic non-differential curves into an ordered form of mathematics. Coined by Mandelbrot, a fractal is a new branch of mathematics that defies the concept of Euclidian geometry.

HYPOTHESIS: The concept of Mandelbrot's fractional dimension was demonstrated with the use of computers.

PURPOSE: By incorporating existing fractal programs written in BASIC and the author's original Pascal programs, the world of fractals was introduced in an elementary math level.

PROCEDURE: With the use of an Apple IIe and an Amiga computers, currently published fractal programs were used in the demonstration. Furthermore, a number of recursive Pascal programs were written to illustrate the figure with an infinite perimeter but with a finite area.

RESULTS: The concept of self-similarity was shown by both BASIC and Pascal programs. All but one fractal program lies in a dimension between the first and the second. One three dimensional fractal was mentioned in this paper. However, the author is eager to pursue further into this intriguing branch of modern mathematics.

#First Award - National Aeronautics and Space Administration

CRYPTOGRAPHY: USING PUBLIC-KEY ENCRYPTION

Johnston, Robert G., Jr., Martin County H.S., Stuart, FL 33497
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The Purpose of this project is to determine if public-key encryption is a safe method of transmitting coded messages.

The Hypothesis was to write a computer program that will determine how long, on average, it will take to decode a message which was encoded by public-key encryption.

Experimentation involved learning Euler's Totient Function and the Modulo Function. Two programs were written: one to find all prime numbers needed by the second program, and the other to find prime factors of numbers in order to decode messages. Because of computer limitations, small numbers were factored. From the data collected by the factoring program, extrapolation was used to determine how long it would take to factor 100 digit numbers.

The Findings and Conclusions reached show that factoring a one or two digit number is a relatively simple procedure which takes a minimal amount of time. Beyond these numbers it becomes necessary to use a computer. As the size of the number increases the time required rises dramatically. It is evident that if large numbers were used such as 100 digit numbers, it would take even a computer an astronomical amount of time. A conservative estimate of 100 digit numbers would be several trillion years given the speed of current main frame computers. It appears evident that at this point in time the public-key encryption method of transmitting messages is a safe one.

THE MANDELBROT SET

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In the world of modern mathematical simulations, there exists a constant problem of unyielding order. Everything is reduced to simple planes, polygons, and equations. This order tends to make simulations unrealistic. A new field of math and computer science, however, is bound to change all that. It is called fractal geometry, and its basic principle is centered around the use of complex (or simple in some cases) equations to isolate numbers that, when plotted, create organic-looking patterns. Even though this is a relatively new field, several useful applications have been found for it, including the analysis of molecular vibrations, the generation of very realistic computer pictures, and probability analysis. This project simply narrows down the field of fractal geometry into an even newer mathematical phenomenon known as the Mandelbrot Set, named after Benoit B. Mandelbrot, a researcher at IBM and the leading expert on fractal geometry. In this project a computer program was written to both isolate the Mandelbrot Set from the set of complex numbers and plot it on a computer screen. The resulting pictures were then analyzed to determine the accuracy of the program and to observe the properties of the Mandelbrot Set. To summarize the conclusions, the program produced startlingly detailed magnifications of the Mandelbrot Set, thus allowing its seemingly chaotic behavior to be reduced to a few simple rules governing its repetition and general form.

MEDICINE AND HEALTH

#CHANGES IN THE DIGESTIVE PROCESSES DUE TO THE LONG TERM INGESTION OF TETRACYCLINE HYDROCHLORIDE

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The micro flora of the intestinal tract has an enormous population of both anaerobic and aerobic bacteria. Oral ingestion of antibiotics has been proven to alter the types and numbers of the intestinal flora. It has been hypothesized that the altered bacteria colonies of the intestinal tract could affect the absorption of fatty acids.

Several factors have been investigated as causative agents of atherosclerosis: diet, heredity, lack of exercise, and the usage of cholesterol lowering drugs. I hypothesized that if the intestinal flora were significantly altered by the long term ingestion of antibiotics, the digestive processes leading to atherosclerosis would be enhanced.

Twenty-four mice were divided into three groups of 8 each as follows: a)CONTROL-received water ad lib. b)CONTINUOUS TETRACYCLINE-received tetracycline ad lib.(0.625mg/24hrs/ 20g body mass) in drinking water c)ALTERNATING TETRACYCLINE- same concentration as continuous group on alternating weeks.

The continuous group's food passage time was significantly longer than the control's. (432 vs 377 min) As hypothesized, the continuous group had a significantly greater rate of active transport of glucose through the intestinal wall as compared to the control. (300 vs 9.8 mg/dL) The experimental group's intestinal flora population was significantly elevated over the control. (70 vs 44 colonies/ cm2) However, these bacteria were found to be Tetracycline resistance. The continuous group developed a more unfavorable HDL/LDL ratio compared to the comtrol. (2.5 vs 4.7) These correlations indicated that there was likely a relationship between increased atherosclerosis and altered bacteria in the colon.

#Second Award - General Motors ISEF

THE EFFECTS OF HAIR CONDITIONERS ON TENSILE STRENGTH OF HUMAN HAIR

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A traditional problem with human hair care is observed when the keratin hair shaft is subjected to salon and commercial permanent formulas. The treated hairshaft frequently breaks with mechanical applications such as combing procedures. The permanent dries and weakens the keratin shaft of the hair. To reduce the amount of hair damage, hair conditioners are used to strengthen the keratin shaft by adding lost oils and minerals. The objective of this research is to determine the proper hair conditioner needed to effectively strengthen the keratin shaft under the influence of a permanent formula. Test samples of hair were divided into texture groups of course, medium and fine. Each test group was treated with three different permanent formulas. Three keratin shafts representing each texture and permanent formula were treated with eight different conditioners. The results were compared to a non-permanent control group. The total procedure was repeated. The result indicated a positive improvement of tensile strength at an average increased stress length of 4¼ millimeters. The average amount of force required to break the hair was 23,520 dynes. Furthermore, test indicated an interrelationship between hair texture and the type of conditioner applied.

#USING SALIVARY CORTISOL LEVELS TO MEASURE STRESS IN ADOLESCENT ATHLETES

Gibson, James, William Henry Harrison High School, West Lafayette,IN
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Cortisol, a glucocorticoid produced by the adrenal cortex, is present in the body both during and immediately after a stress related encounter, involving the release of adrenaline and noradrenaline. Studies have shown a correlation between physical exercise and blood serum cortisol levels, indicating that the higher the intensity of the exercise, the higher the cortisol levels. Research also indicates that serum cortisol levels may be affected by the presence of other substances in the blood, whereas salivary cortisol levels would not be affected; even though a direct correlation has been found to exist between salivary and serum cortisol levels.

This study study utilized fourteen adolescent males between the ages of 14 and 17. Each subject was either a member of the William Henry Harrison High School cross country or swim team. Each athlete supplied saliva samples before, during and after practice sessions and competition. Using radioimmunoassay techniques (RIA), the samples were analyzed for cortisol content, which was then compared with several factors, such as heart rate and physical fitness.

Results indicate a positive correlation between both resting and excited cortisol levels and resting and excited heart rates. Results also indicate that both the cortisol level and heart rate correlate negatively with a subject's level of physical fitness. In addition, while mental stress brought on by competition did not affect subjects' heart rates, it did correlate positively with subject cortisol level and competitive success. Results suggest that monitoring subject salivary cortisol levels may prove to be an acceptable technique in the diagnosing and treatment of both physical and mental stress and stress related disorders.

#Fourth Award - General Motors ISEF

AIDS -THE PLAGUE OF THE 80S

Wanat, Michele R.,West Holmes High School, Millersburg,OH 44654
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The purpose of this project is to inform the public of the facts about AIDS and to dispel common misconceptions. Information was obtained by search of current literature, written requests to health care professionals for policies related to care of AIDS patients, attendance at AIDS seminars, and completion of the HTLV-III Antibody Test. AIDS is a controversial subject which frightens many people. This project should support facts to help relieve anxieties concerning AIDS, and to enable all to understand that AIDS is not easily transmitted.

AIDS (Acquired Immune Deficiency Syndrome) is a fatal condition that breaks down the body's immune system; symptoms mimic other illnesses. AIDS is transmitted by intimate sexual contact and through blood transfusions or drug abuse blood contact. Four main risk groups include homosexual/bisexual men with multiple contacts,IV drug abusers, hemophiliacs, and Haitians.

AIDS is causing public fear of donating desperately needed blood. Through a blood screening test, the HTLV-III antibody can be identified, reducing transmission risks. All donated blood is now screened.

There is no evidence that shows a victim should be kept from attending school or work if they have no draining wounds. AIDS is not transmitted through casual contact.

Although there is no cure for AIDS at this time, there are precautions to avoid contact with the virus. AIDS victims should be allowed the chance to live out their lives in dignity; after all, they are the ones who are suffering.

THE ANTISEPTIC ACTION OF MOUTHWASHES ON THE OCCURRENCE OF BACTERIA AT DIFFERENT SITES IN THE MOUTH

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Can mouthwashes help contribute to killing bacteria in the mouth?

Mouthwashes now account for sales of something like $350 million a year. Much of that mouthwash is sold merely to freshen breath-a legitimate cosmetic use though hardly a vital hygienic function. Yet, mouthwash manufacturers, true to their products past as patent medicine, often promise-or seem to promise-even greater potency.

Innoculate agar plates with bacteria from different sites of the mouth. Study resulting bacteria, apply mouthwashes, and examine plates for a zone of toxic inhibition.

Results show no indication of any toxic inhibition or killing of bacteria.

In summary of my tests, mout-hwashes show no action in killing or toxic inhibition of bacteria.

#WHAT TYPE OF LENS BEST PROTECTS THE EYES FROM X-RAYS?

Chernin, Ophir S., University High School, Tucson, AZ 85711;
5721 E. 6th. St. Tucson, AZ 85711.

To measure the X-ray attenuation of lens materials, we took X-ray pictures of each lens. Then we read the film's optical density and measured the thickness of each lens, therby giving us the data to calculate the X-ray attenuation of each lens. The result was that the leaded glass worked best. Second, was the rose-tinted Hilite lens. We also found that each lens absorbed fewer X-rays when X-ray energy was increased.

#Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

AN EXAMINATION OF THE EFFECTS OF A DEFICIENCY AND A TOXICITY OF VITAMIN A IN THREE CONSECUTIVE GENERATIONS OF RATTUS NORVEGICUS

Seay, Scott, Center Grove H.S., Greenwood, IN 46142;
1757 West Demaree Road, Greenwood, IN 46142.

No exhibit.

*PREPARATION OF AN EMOLLIENT LOTION "^{o}/w" USING THE MOMORDICA CHARANTIA LEAVES EXTRACT AS A REDUCTOR AGENT OF PITYRIASIS VERSICOLOR

Cruz Martinez, Edgardo - John F. Kennedy High School
Santa Isabel, P. R. 00757
Bo. Ollas No. 494 - Apt. 942 - Santa Isabel, P. R. 00757

This project tries to give a remedy to a fungal disease that many people have. It is called Pityriasis versicolor caused by Malassezia furfur. The symptom of this disease is that it only invades the superficial part of the human epidermis and it form scally patches all over the body.

To do this investigation tests in vitro and in vivo were made. The concentration disc technique realized revealed that the extract, at any concentration, was effective. Then, there were selected twenty person with the disease and were gathered in 4 groups equivalent to the concentrations of 100%, 75%, 50% and 25% of Momordica charantia leaves extract. Three areas of the body were selected per person which were treated with the same extract once a day, twice a day and three times a day during a month. The colonies were counted and measured weekly to see if there was any difference.

Biochemical analysis were done with the extract to determine its basic constituents, like pigmentation, pH, aminoacids and foliar analysis.

After concluding that the Momordica charantia leaves extract reduces the disease an emollient lotion was designed using the "Emollient lotion ^{o}/w anionic type" method. The use of the lotion called "Cru-Thie" applied with 25% extract: 75% destiller water, and 50% extract: 50% destiller water in the aqueous phase reflects results similar as those of the extract. It was concluded that Momordica charantia leaves extract and "Cru-Thie" lotion in different concentrations are effective as a reductor agent of Pityriasis versicolor.

*Fourth Award - General Motors ISEF

A NATRIURETIC AND DIURETIC EFFECT ON MYOCARDAAL EXTRACTS IN RATS

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A new hormone-like substance has recently been reported in the literature. The objectives of this research were to determine: the effect of vhanges in water and sodium balance on atrial natriuretic factor (ANF) and the effects on the excretory system in male rats; and a dosage response relationship between ANF and the excretion of Na and water. Twelve animals were placed three different diets of high, low, and normal Na. After three weeks, the ANF was extracted from cardiac muscle. The various ANF concentrations were tested on bioassay animals. It was found that ANF produces nearly a two-fold increase in Na and nearly a five-fold increase in Cl. ANF from a high Na diet, wiht the implantation of DOCA tablets, produces increases in each ion tested. ANF from a low Na diet produced a 4.5-fold increase in Na, a 1.5-fold increase in K, and a 3.5-fold increase in Cl. It was shown by the dosage respone that a 1½ atrial dosage proved to cause the largest natriuretic response. It was discovered that the low salt animals, the high salt animals, and the controls exhibited mean hematocrits of 53%±0.6, 42.3%±1.0, and 47.4%±o.6, respectively. The hematocrit value from the high Na diet indicates that a high fluid volume was pres present; this suggests that ANF was active in the body and not being stored in the atria. The data suggests that a low Na diet causes the atria to store ANF since a larger percentage change is seen in Na and volume and by the low hematocrit value. These discoveries could contribute greatly to the regulation of blood pressure in man.

#INJECTABLE CONTROLLED-RELEASE ESTROGEN MICROSPHERES FOR HUMAN AND VETERINARY USE

Lewis, Amy L., Hartselle High School, Hartselle, AL 35640
Route 2, Box 214E, Hartselle, Alabama 35640

The objective of this research was to prepare and characterize in vitro and in vivo in baboons a new controlled-release estrogen microsphere system. The resulting product is expected to be useful in adult women for estrogen replacement therapy and as a combination injectable contraceptive. A single long-acting injectable microsphere product would be easier to use and possibly safer and more effective than daily oral tablets or capsules. In the veterinary field, the long-acting estrogen system also offers potential as a component of a pet contraceptive and as a growth stimulator for cattle. Ethinyl estradiol was microencapsulated in biodegradable poly (lactide-co-glycolide). The resulting microspheres contained 39 wt.% of drug and were 25-45 microns in diameter. Residual processing solvent was found to be less than 0.1 wt.%. Scanning electron micrographs revealed the microspheres were of slightly rough texture and no free drug crystals were present. In vitro release studies on the microspheres predicted long-term release in animals and humans. Evaluations in baboons confirmed that the drug released from the microspheres was effective for approximately 30 days following a single injection of this previously unreported system. These results demonstrate the feasibility of this approach for estrogen delivery. Future work will involve additional active estrogen components and other biodegradable copolymers.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society

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RADIATION: HOW MUCH IS TOO MUCH PHASE IV

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HYPOTHESIS: Radiation will cause external and internal deformalities, anemia, and infertility in female Mus musculus. PROCEDURE: Expose five groups of virgin, Swiss-Webster female mice to varying amounts of radiation. Each group will contain 10 mice. Group A--0 rads; Group B--25 rads; Group C--50 rads; Group D--100 rads; Group E--150 rads. Observation of blood anemia, leukopenia, packed cell volume, infertility by a vaginal lavage, external and internal deformalities by a gross autopsy and histological studies. DATA: 50 rads or more causes infertility in female mice. The infertile mice stay in either an estrus or proestrus period of their cycles. Blood anemia is noticed at a level of 25 rads. Leukopenia is noticed at 50 rads. Packed cell volume is not noticed at one week past exposure. No external deformalities are noted. The thymus gland is smaller in the irradiated mice. Radiation causes the cells in the body to become a dense, small, non-cornified cells. CONCLUSION: Radiation cuases infertility in female Mus musculus at a level of 50 rads or more. It also cuases anemia and leukopenia. External deformalities are not noticed because of the amount of radiation used in this experiment. In a gross autopsy the only noticeable difference in the glands is the thymus gland being much smaller in the irradiated mice. The histological studies showed that the cells structure is what is damaged by the radiation. The cells are much smaller and denser. They are more of a non-cornified cell than a cornified cell.

#THE EFFECT OF Zn^{+2} ON NUCLEAR POLYHEDROSIS VIRUS INFECTIONS

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It has recently been demonstrated that zinc ions may serve as anti-viral agents in Rhino-viruses and Herpes-simplex viruses. Yet, if ions are truly anti-viral agents, then they should also suppress non-human viruses as well. This study tested this hypothesis by subjecting 1st and 2nd instar wax moth larva to nuclear polyhedrosis viruses. These larva were then selectivley exposed to either $ZnCl_2$, $ZnSO_4$, NaCl, or Na_2SO_4.

Data from these studies indicate that Zn^{+2} exposure reduces both the percentages of cells infected and percentages of cell lysis. This anti-viral capability is most efficient when wax moth larva are exposed to Zn^{+2} ions during the early stages of viral infection. The exposure to Zn^{+2} does not alter the viral capsid proteins and thus prevent the viruses from entering host cells. Instead, Zn^{+2} ions effect host cell biocehmistry. This conclusion was learned by exposing wax moth larva to various concentrations of $ZnCl_2$ after the larva were exposed to nuclear polyhedrosis viruses. Then at various times after initial NPV exposure, DNA, RNA, and proteins were extracted from wax moth larva. DNA levels were determined by using the diphenylamine assay. RNA levels were determined by using the orscinol assay, while protein levels were determined by using the Biuret assay. Data from these studies indicate that Zn^{+2} exposure depresses DNA, RNA, and protein levels. This reduction in DNA, RNA, and protein apparently prevents the replication of nuclear polyhedrosis viruses. This action may be caused by Zn^{+2} ions serving as an inhibitor for the Ca^{+2} and Mg^{+2} dependent RNA and DNA polymerases.

#Third Award - General Motors ISEF

#THE EFFECTS OF SMOKING ON THE HEALTH OF MAMMALS

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This experiment was done to show the effects of smoking on the health (respiration and endurance as well as permanent physical damage) of mammals. I obtained 25 gerbils from 5 different age groups with 5 in each group. Four in each group were experimental and the other was a control. By counting revolutions per minute in an exercise wheel and timing the intake of 150 cubic inches of oxygen, I was able to obtain endurance and respiration rates. After figuring averages for each specimen, I began exposing each experimental group to cigarette smoke. After the first week, one specimen from each group was sacrificed and the lungs, heart and trachea were removed and sent to a pathologist for histologic reports. This same procedure was continued for a total of 4 weeks, at which time, the controls were also sacrificed. In conclusion, I found a great reduction in endurance and a great increase in respiration rate among smoking gerbils. These changes were also notably more extreme in the younger specimens. The oldest specimens, 6 months, were almost not affected by the cigarette smoke. I hold the fact that exposure time was only one month accountable for these results. The variety in measurements in both respiration and endurance rates for control specimens could be attributed to change in both barometric and air pressure. This, of course, is only an idea and has not yet been tested. This experiment has been done to a lesser degree using white mice and so the title can include the word "mammals" instead of "gerbils."

#First Award - American Medical Association

ANTIBACTERIAL PROPERTIES OF LYSOZYME ON BACTERIA WITH DIFFERENT GRAM REACTIONS AND MORPHOLOGIES

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In 1922, Fleming discovered Lysozyme and classified it as a muramidase. This is because Lysozyme eliminates the oxygen atom in the carboxyl group of Muramic Acid, the principal component of bacterial cell walls. It is this "lysing" action that gives Lysozyme its name. This project was originally designed to determine why a dog's wound heals so quickly when the dog licks the wound.

The testing in this research project was designed after Fleming's tests on Penicillin. This was the sensitivity testing technique. This was used with a twenty-four hour broth culture inoculated onto a petri dish. These plates were incubated at twenty-four hour intervals for seventy-two hours and the diameter of each was measured at each of these intervals. There were six test bacteria of each Gram reaction. These were: *E. coli*, *A. faecalis*, *S. aureus*, *S. mitis*, *S. marcescens*, and *S. lutea*. There were three test substances: human saliva, canine saliva, and egg whites; and the control was distilled water.

Results indicate that egg whites were a very strong antibacterial agent. The results also show that canine saliva, when in conjunction with the licking action of the dog, which cleans the wound, proves to be of some antibacterial value. Human saliva, on the other hand, proved to be of the poorest antibacterial value because of the fact that in three of the six bacterial tests on human saliva, bacterial growth was inhanced.

AN INVESTIGATION INTO THE PRODUCTION OF INTERLEUKIN-2 BY GUNSHOT VICTIMS AS COMPARED TO HEALTHY INDIVIDUALS WITH APPLICATION TO THE TREATMENT OF TRAUMA PATIENTS.

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I examined the differences of interleukin-2 (IL-2) production of two gunshot victims and two healthy individuals. Lymphocytes from the blood of the four individuals were cultured in four media, two with a mitogen, phytoheamaglutinin, to induce T-cell proliferation and two without a mitogen. The cultures were run for 48 and 96 hours at 37 degrees celsius with 5% CO_2. After being cultured, the supernatent was removed from each culture and an IL-2 dependent cell line, HT-2, was used to innoculate the supernatents. The HT-2 cells were also placed into a fifth medium of known IL-2 content to insure IL-2 dependency in the HT-2 cells and also for a positive control. The HT-2 cells were then cultured in these media for 36 hours at which time they were pulsed with radioactive thymadine and cultured for an addition 4 hours. At the end of the culture period, counts were taken using a scintillation counter to determine the amount of growth in each media.

A reduction in the amount of HT-2 cell growth and therefor a reduction in the amount of IL-2 produced was seen in both of the gunshot victims. This reduction was seen in all dilutions of IL-2 tested. However, I was only able to test a few individuals and much further testing must take place to show this reduction to occur consistantly. If this reduction does always occur, it may be possible to treat gunshot victims, or trauma patients in general, with some form of IL-2 to prevent many of the adverse after-effects of trauma, such as hemorraging or infection.

THE EFFECTS OF PESTICIDES ON MUSCLE CONTRACTIONS

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This project determined the toxic effects of pesticides on nerve and muscle function in rodents by distinguishing how 4 different pesticides affect the work a muscle can do. On an individual basis, 12 male rats ± 10 weeks were sedated with an injection of ½cc Ketamine to 4cc Saline and anesthetized with Halothane. An incision was made in the hind leg exposing the sciatic nerve so the gastrocnemeus muscle could be stimulated to graph muscle work. A control contraction was recorded. Three cc of a single pesticide, Paraquat, Diazinon, Subdue or Rodeo, of one concentration, Full Strength or 1:2 or 1:6 (Pesticide:Saline) were injected subcutaneously in the rat's back. With each rat serving as its own control, work was recorded for an hour, and the rat was euthanized by increasing the dose of Halothane.

Paraquat had the strongest effect on muscle work with an average reduction of 93% and, Diazinon, the least with an average decrease of 74%. Subdue and Rodeo had similar muscle work reductions with an average decrease of 89% and 87% respectively. The equipment worked well and the modified anesthesia machine was more efficient. Pesticides do have an effect on nerve and muscle function which occurs because of toxicity to the neuromuscular junction or to other body organs. The reduction of muscle work varies with each pesticide and with the concentration of each pesticide.

Increased pesticide poisonings and recent neurological reactions to pesticides led to this year's use of equipment previously designed to study neuromuscular interactions. In a warm, humid climate pesticides are a necessary means of pest control capable of attacking human organ systems. This research may aid the study of pesticides and their neurotoxic properties.

#First Award - American Medical Association
First Award - United States Air Force
Second Award - General Motors ISEF

THE EFFECTS OF ZINC, RETINOL, AND ASCORBIC ACID ON ALUMINUM-INDUCED PRESENILE DEMENTIA

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The purpose of the project was to determine whether zinc, in conjunction with retinol and ascorbic acid, would decrease the amounts of aluminum which reach the brain, thus decreasing the chances of acquisition of presenile dementia.

Eighteen rats in 6 groups were administered aluminum, zinc, retinol, and ascorbic acid in five combinations with the sixth cage acting as a control group. The first group of rats, one from each cage, was sacrificed after four weeks, the next after eight, and the last after twelve.

Brains were surgically removed and placed in hydrochloric acid which was then heated to extract aluminum. This solution was diluted in distilled water and tested, using a LaMotte's colorimeter.

Preliminary results indicate that zinc is effective in the reduction of aluminum in the brain, but only during short-term observation. The retinol's action seemed to be hampered by the presence of the zinc. Ascorbic acid, however, proved to be very effective. Therefore, the conclusion is that aluminum levels in the brain can be reduced by an adequate amount of ascorbic acid in the diet.

L-ASPARTYL-L-PHENYLALANINE METHYL ESTER EFFECT ON RATTUS NORVEGICUS ESTROUS CYCLE

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The purpose of this project was to observe the effects of aspartame on mammals. The mammals used were Rattus norvegicus because they have a reproductive cycle similar to a human's, they could be given aspartame in the same manner a human consumes it, and the stages of their estrous cycle can be easily distinguished by cell changes.

The fifteen subjects in the experiment were divided into three groups of five subjects: a control group (Group N), received no aspartame; one group was given the recommended daily dosage of aspartame (Group S); and an overdose group (Group A) which received one hundred times the recommended daily dosage. The subjects were given aspartame in the form of a granulated sweetner which was placed in their water bottles.

To observe the effects of aspartame on the subjects' estrous cycle, vaginal smears were taken every third day to observe changes in the cells or stages.

From the information gathered, the onset of the estrous cycles was delayed directly from the use of aspartame. The subjects receiving aspartame showed that their stages were significantly different than what was predicted. Further research should be done to confirm these conclusions. The techniques used interfered with the stages of estrous and/or vaginal cell production. Further research with other techniques should be conducted, possibly with vaginal smears, to observe the stages and/or cell changes.

The subjects receiving aspartame gained more mass 60% of the time, and the overdose group consumed more water.

#THE EFFECTS OF NON-PRESCRIPTION DRUGS ON EYE-HAND COORDINATION

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The purpose of these experiments is to find out whether or not a non-prescription cold remedy which claims not to cause drowsiness affects the eye-hand coordination of individuals.

Using a reaction timer, subjects were tested on their reaction to light and sound. Each subject's eye-hand coordination was tested by using a contoured shaped game board and a plastic container with a round hole in the corner. These same subjects were given non-prescription cold remedies in the prescribed dosage and the exact same tests rerun. Scores on each subject were compared using the t-Test.

These experiments seem to indicate that Sudafed does not detrimentally affect a person's ability to perform the specified tasks involving reaction time where as Benadryl does seem to have a slight effect.

#Third Award - American Optometric Association and Auxiliary to the American Optometric Association

REMISSION OF CARCINOMA, IN MUS MUSCULUS, USING CYCLOPHOSPHAMIDE

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This is the fourth year of working with the effects of cyclophosphamide (cytoxin) on mus musculus. In the first year cytoxin was administered in low dosages, in a study of behabioral changes compared to a control. It was noted that behavior patterns were altered.

The second year cytoxin was administered in low dosages, to study reproduction patterns. No preganies occurred and no death loss the adult resulted.

Year three cytoxin was administered in low dosages, after carcinoma was induced into their systems, under supervision of Dr. Norman. Measurment of tumor growth was determined and records kept on weight changes. It was determined that this was not a suitable control method, as no size reduction was noted.

In year four (1985-86) cytoxin was administered in low dosages in hopes of controlling advanced stages of development in carcinoma. Application of cytoxin was for one month and then a rest period of two weeks was allowed. Cytoxin was administered for two weeks and a one week rest period followed. The test period continued in the above pattern for 125 days. During the above time period, the tumors of carcinoma were beginning to decline in size; after another four to six weeks the tumors of carcinoma could not be detected. On April 2,1986, two doctors from Angelo State University, in the biology department, observed the mus musculus, and reported that carcinoma was possibly detected in the muscle as fatty tissue or a tumor in only one mus musculus. The other mus musculus showed no signs of carcinoma. It is concluded that a remission state was obtained.

ARE LASERS THE SOLUTION TO WORLD HUNGER?

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Since all animals, including man, are dependent for their fuel on the solar energy trapped by plants, how many people we can feed depends on the amount of energy trapped by photosynthesis. To what extent can the two hundred billion tons of carbon stored in plants per year be increased?

The purpose of my study was to determine if a concentrated source of light could increase the rate of photosynthesis. I used a He-Ne, .5 mW, Class II Laser, emitting an orange-red light at 632.8 nanometers.

The first step in my study was to isolate two plants for 24 hours in the dark. This caused the starch found in the leaves to translocate to the roots. I treated one leaf of each of the five geraniums and one each of the five broccoli plants, for various lengths of time. The leaves were then boiled in water and then in ethyl alcohol to remove the chlorophyll. An iodine solution was used to detect the presence of starches in the area of the leaf that was exposed to the laser beam. Unexposed leaves served as a control.

My study indicated that concentrated light from a laser is a stimulus for increasing the rate of photosynthesis. Further studies may lead to the conclusion that concentrated light from a laser or some other source would greatly increase the rate of food production and thereby possibly help eliminate world hunger.

THE SEAMLESS IMPLANTABLE ARTIFICIAL HEART WITH DRIVE UNIT AND PORTABLE DRIVE UNIT

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The purpose of the project is to see if a high school student can develop and construct a seamless implantable artificial heart with drive unit and portable drive unit.

The procedure is to design a series of artificial hearts with each stage of the series having one or more of the flaws of the previous series corrected until a suitable, operable artificial heart was obtained and in the same manner the drive unit and portable drive unit were produced.

Through following the before mentioned procedure I have obtained the results as follows: a seamless implantable artificial heart. A stationary drive unit capable of sustaining the artificial heart indefinitely and finally a portable drive unit to give a patient greater mobility for between 30 and 45 minutes.

In conclusion, let me state that I feel the Y-series artificial heart and drive units have come a long way, yet still have a great deal of modifications ahead of them.

The artificial hearts of all types and designs will in the future have great applications in saving and bettering the life of terminal cardiac patients, but all designs currently in existence need to be reviewed and have some major changes made in their over-all designs.

#Fourth Award - General Motors ISEF

MUSIC LOWERS CARDIOVASCULAR FUNCTIONS--A TWO YEAR STUDY

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What effect does classical music have on cardiovascular functions? Results from the first year's study indicated that rock music increased pulse rates of adult and student subjects; classical music decreased pulse rates of both. This year's research was designed to see if a non-medical, non-chemical approach could be used to regulate cardiovascular functions. The hypothesis stated that classical music would reduce both pulse rate and blood pressure and that adults with a history of hypertension would have a greater reduction than those without hypertension. Forty subjects (20-history of hypertension; 20-no history of hypertension) were given a questionnaire. Subjects' pulse counts and blood pressure were measured before and after listening to a two minute classical selection (Tchaikovsky's 1812 Overture). The results supported the hypothesis. After two minutes of the selection all subjects' pulse and blood pressure dropped. Out of 120 readings, 112 dropped and merely 8 remained unchanged. Both groups pulse rates dropped an average of 13-15 points. However, regarding blood pressure, those with a history of hypertension, had mean systolic and diastolic readings that dropped 13 and 9 points respectively. For those with no history, the drops were only 9 and 5 points. Most measurements dropped noticeably but statistical analysis did not reveal any significant correlation in the drop pattern of the pulse rate with either blood pressure measurement. It appears that classical music most definitely provides an additional alternative to lowering cardiovascular redings in hypertension patients.

ALCOHOL'S EFFECT ON BLOOD COAGULATION

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RR1, Mahnomen, Mn 56557.

The purpose of this research was to find how blood coagulation is affected by alcohol, since many auto accidents are alcohol related.

Blood was drawn by a lab technicion through 1) a finger puncture and 2) veinously, in six male subjects. Blood samples were taken before and after alcohol consumption. The clotting time was measured and PT (Prothrombin Time) and PTT (Partial Thromboplastin Time) were counted using the fibrometer method.

Freshly collected blood was mixed with sodium citrate and centrifuged. PT was measured by using a mixture of Activated Thromboplastin and calcium chloride mixed with test plasma forming a fibrin web. PTT was measured by adding test plasma to ACTIN followed by the prewarmed calcium chloride. The fibrometer then measured the time to form the fibrin web. Procedures were repeated three times and averaged. The same procedures were used to find controls but CiTrol was added in place of test plasma.

The clotting time increased after alcohol consumption in four of the subjects, one remained the same, and one decreased .15 second.The PT increased in four test subjects after alcohol consumption, and decreased slightly in two. The PTT increased in all six test subjects, after alcohol consumption.

This research indicates a possible slower rate of blood coagulation time due to alcohol consumption. Thus blood loss and recovery time due to accidents could be increased by alcohol. Since many accidents are alcohol related this research suggests further study in blood coagulation.

THE EFFECT OF ALOE VERA AND ITS COMPONENTS ON BLOOD GLUCOSE LEVELS

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A blood sample was taken and a small quantity of anticoagulant was added to the blood. The glucose level was tested. The blood sample was split into two parts; one part of the sample became the control, and a fixed quantity of Aloe Vera was added to the other sample. The Glucose level was tested again at various time intervals. The Aloe Vera continued to lower the blood glucose continuously during a 24 hour period.

A glucose molar solution was made to replace the blood glucose for one set of experiments. This was done to ensure that the decreasing effect on the blood glucose was not due to the continuation of metabolizing red blood cells. The sample was split into two parts; again, one being a control. The Aloe Vera was added and the glucose level was tested at various time intervals throughout a 24 hour period. The Aloe Vera lowered the glucose in this solution.

Further research was carried out with each separate component of the Aloe Vera extract. The components were added to the blood; and, the glucose levels were again tested at the same time intervals. No single component lowered the glucose in the blood as the pure Aloe Vera extract did. Therefore, the sum of the components had a greater effect on the blood glucose than did the single components.

# THE EFFECTS OF DIETARY FIBER ON RATTUS NORVEGICUS WITH THE CARCINOGEN AZOXYMETHANE INTRODUCED SUBCUTANEOUSLY

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Evidence indicates that a faster transit time of the feces offers some protection against some forms of intestinal cancer. This project is designed to show if a high fiber diet offers a faster transit time than a low fiber diet and to explain the different effects caused by the differences in transit time. The dietary effects observed were transit time, structure and weight of the feces, structure of the intestine, levels of water intake, and weight of the rats.

This experiment involved fifteen Rattus norvegicus divided into three groups. A diet was prepared for each group containing an equal number of calories while varying the fiberous content. Colored food additives were used every seven days to assist in measuring transit time. The intestinal carcinogen Azoxymethane was injected subcutaneously in equal amounts to each group trying to enhance the formation of carcinomas. Electron micrographs were made of the feces. The weight of the feces was calucated by taking five select fecal pellets from each group. Cross-section slides of the colon and rectum were made and microscopic photographs were taken to show any differences in structure.

The results of the study indicate an inverse relationship between the quantity of fiber in the diet and the transit time, muscularture of the intestine, and weight of the rats. The water intake and the volume of the fecal pellets were directly related to the fiber content, but the weight of the fecal pellets remained the same.

#Fourth Award - General Motors ISEF

THE EFFECT OF NARCOTIC ANTAGONIST ON "JOGGER'S HIGH"

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Most people today like to exercise. Many say it makes them feel better. Scientists call this the jogger's high. It is believed that this could be related to chemical compounds produced in the brain called endorphins. These are released when you exercise and could be the cause of jogger's high. The purpose of this four year project is to try to determine if endorphins are the cause of jogger's high.

Forty five mice were divided into nine groups of five. The first day each mouse was allowed to exercise as much as it desired to for five minutes in a gerbil wheel. The number of times the mouse voluntarily turned the wheel in five minutes was counted and recorded.

The next seven days group #1 stayed in their cages. Group #2 stayed in their cages, but was given a dose of Narcan of .01mg/kg body weight. Group #3 stayed in their cages, but received a dose of Narcan, that was twice the amount of a normal dose of .01mg/kg body weight. Group #4 was exercised daily for five minutes on a treadmill. Group #5 was exercised daily for ten minutes on a treadmill. Group #6 was exercised daily for twenty minutes on a treadmill. Group #7 was exercised daily for ten minutes on a treadmill, but received a dose of Narcan of .01mg/kg body weight. Group #8 was exercised daily for twenty minutes on a treadmill, but received a dose of Narcan of .01mg/kg body weight. Group #9 was exercised daily for twenty minutes on a treadmill, but received a dose of Narcan that was half the amount of a normal dose of .01mg/kg body weight. After those seven days each mouse was given the choice to exercise in a gerbil wheel for five minutes. The number of times the wheel turned in five minutes was counted and recorded. It was found that increasing the amount of exercise does not increase the jogger's high.

GXT, STRESS, AND CORONARY HEART DISEASE

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PURPOSE: To examine how different levels of emotional stress can affect subjects' GXT or Graded Exercise Testing (ECG and Blood Pressure), and how this and other information such as questionnaires can help predict future development of Coronary Heart Disease.

PROCEDURE: The experimentation of this research is divided into two parts. First, 100 students answered questionnaires in order to measure the levels of stress they were exposed to. From this group, 20 students were selected to be subjects in a Graded Exercise Testing (Stress Test). ECG and blood pressure readings were recorded when they were at rest and after 3 minutes of exercise (jogging for 3 minutes). Results from questionnaires and GXT results were analyzed and correlated according to sex, age, and race.

CONCLUSION: A vast majority of the students were exposed to severe levels of stress. Black male subjects under severe levels of stress also showed the largest variations in ECG and blood pressure readings. This gives a direct correlation with the death rate caused by heart disease. In 1980, black males had a higher rate than any other group. This shows that signs of future coronary heart disease do not start at the middle age with hypertension, but can start during adolescence.

THE HEART: HOW ORAL MEDICATIONS AFFECT THE HEART RATE OF THE DAPHNIA

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Heart disease is the number one killer in the United States affecting both children and adults; knowledge, therefore, related to the heart's functioning when influenced by external stimuli is vital. One of the most prevalent external stimuli is the use of oral medications. By introducing individual medications to a healthy heart, an analyzation of its influence can be determined.

Since experimentation on a healthy human heart is unethical, a daphnia's heart was utilized. The oral medications analyzed were the following: Tranzene, Elavil, Lanoxin, Motrin, Mysoline, aspirin, caffeine, and alcohol.

Findings using a T-test showed a significant difference in heartbeat. The only exceptions were in the application of alcohol and Tranxene. The observable results were comparable to the anticipated results that pharmaceutical companies ascribe to the medications.

Conclusions can be drawn primarily in the area of self medication; an individual should avoid taking any medication without a doctor's prescription and should inform his doctor of all other medications being taken.

Subsequent research will be needed to determine the type, mixture, and amount of medication an individual will need to take in order for his heart to function at an optimum level.

GROWTH OF SEDIMENTARY BACTERIA IN GLASSES AFTER EXPOSURE OVERNIGHT IN A RESTAURANT

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The main purpose of my experiment was to prove the effectiveness of placing drinking glasses upside down for storage on a table. First I decided on a testable environment (restaurant). Next, I mixed the agar in a large beaker, poured it into petri dishes, and autoclaved them for twenty minutes to kill any bacterium present in the agar or on the petri dishes.

At the restaurant, I placed the petri dishes (one face up, one face down) on each table and left them exposed to air. I let them remain open to the air overnight. The next day, I picked up the dishes and incubated them at 37° celcius for seventy-two hours to allow for the colonies to grow. I counted and recorded the number of colonies and graphed the results.

The data showed that less bacterium settled in the petri dishes if placed face down on the tables. A second trial came up with almost identical results. A feasible application of these results could be to use further research in determining the temperature at which these bacterium ceased to thrive, and lower the sterilization procedure temperature to just above this. This will aid in the conservation of energy, and save restaurant owners a lot of money.

As a result of my experiment, I hope to raise health standards set by the Department of Health and other protection and safety agencies. Though many standards and procedures have been set for cleanliness, nothing has been directed to glasses, and I set out to change this.

THE EFFECTS OF ASCORBIC ACID ON E. COLI

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In part I of the study ascorbic acid (Vitamin C) was added to broth tubes to produce concentrations of .01%, .025%, .05%, .1%, .5%, 1%, 2%, and 2.5%. These tubes were inoculated with common E. coli and relative growth was determined by absorbance spectrophotometry.

In part II of the study both agar and broth tubes were prepared with the above concentrations of ascorbic acid and sensitivity testing was done with the E. coli that had been exposed to ascorbic acid in their broth and agar. Sensitivity to Penicillin, Tetracycline, Erythromycin, and Chloromycetin was measured by inhibition zone size.

Through the large amount of data obtained in the growth rate portion of the study, it was determined that exposure to ascorbic acid in both high and low concentrations does not effect significantly the growth rate of E. coli. However, in the second portion of the study it was found that E. coli exposed to higher concentrations of ascorbic acid became more resistant to Tetracycline than the control. More research is needed to clarify this dilemma and further investigate the observed phenomena.

The fact that bacteria exposed to high concentrations of ascorbic acid become more resistant to Tetracycline may further change the image of Vitamin C as a panacea. By increasing bacterial resistance to antibiotics, large doses of Vitamin C could actually be more harmful than helpful.

INHIBITORY EFFECT OF INTERLEUKIN 2

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Interleukin 2(Il-2) is a lymphokine produced by mature, antigen-specific T lymphocytes which induces their proliferation via cell membrane receptors. However, previous studies suggest that Il-2 can control other functional activities of the T cell, such as the secretion of additional lymphokines. Thus, the question of the regulatory effect of exogenous Il-2 on T cell secretion of macrophage activating factor(MAF) was further investigated. To approach this question, lymphocytes from C57/6J mice were activated by the mitogen concanavalin A(Con A) and with alloantigens(in a mixed lymphocyte culture, MLC, with non-viable lymphocytes from DBA/2J mice). Two Con A cultures and two MLC's were studied in which one culture of each culture type was treated with Il-2. After four days incubation, the cultures were assayed for proliferation, and the culture supernatants were assayed for MAF activity by their ability to elicit macrophage cytolytic activity. The data from these experiments showed that the supernatants from the Il-2 treated cultures elicited less macrophage cytolytic activity than did the supernatants from the cultures not treated with Il-2. In contrast, the Il-2 treated cultures exhibited more proliferation than did the non-treated cultures. These results indicate that exogenous Il-2 inhibited MAF secretion by short-term T cells while enhancing their proliferation. It therefore follows that the T cell's initial response to Il-2 treatment is to proliferate, and protein is synthesized by the cell mainly for this purpose. To conserve its protein for use in cell division, the T cell represses its production of lymphokines such as the MAF.

#First Award - American Medical Association
First Award - Tissue Culture Association
Second Award - American Society for Microbiology
Second Award - General Motors ISEF

THE EFFECTS OF CARBOHYDRATE LOADING ON EXERCISE ENDURANCE IN LAB MICE

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Carbohydrate loading is a dietary manipulation practiced by many athletes to enhance their endurance and achieve better performance. This involves varying carbohydrate intake during different phases of training.

The purpose of this experiment was to test the effects of carbohydrate loading on exercise endurance in laboratory mice.

Group 1 received a normal balanced diet and was exercised for 10 minutes daily on a treadmill for 6 days.

Group 2 was placed on a carbohydrate loading program for 6 days. The mice received a diet supplemented with carbohydrates on specified days of the training regimen and were exercised accordingly on the treadmill.

Before and after the training regimens were started, each group was tested for exercise endurance capacity. The mice were tested in such a manner that the experimenter did not know which mice were in which experimental group. The times were recorded and compared.

The results showed that Group 2 on the carbohydrate loading regimen showed a significant increase in endurance exercise times over the control group where there was little change in endurance times during the course of the experiment.

A STUDY OF THE CORRELATION BETWEEN EXERCISE LEVELS AND METABOLIC RATE

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It has been observed that humans involved in daily strenuous exercise programs tend to have no problem maintaining their ideal body weight without reducing their food intake. On the contrary, those people seem to be able to indulge in a high caloric intake without gaining weight. Often the daily period of increased activity can not account for the increase in calorie expenditure. If high levels of daily exercise induces a higher metabolic rate which remains slightly elevated throughout periods of normal activity, then the increase in calorie expenditure can be explained. The purpose of this study was to test this hypothesis. Laboratory experimentation with mice demonstrated a statistically significant increase in the metabolic rate of exercised mice in comparison to the non-exercised control group. All animals were provided a complete, free-choice diet during the experiment. Although the results of a similar study using high school students provided unclear results, a positive correlation between an increased metabolic rate and exercise was indicated by a study made of runners and non-runners among the high school faculty. These findings should encourage people who need to lose weight to exercise since, in addition to the calories expended during the period of exercise, calories would continue to be burned during normal activity due to the increase in metabolic rate.

HORMONE EFFECTS ON GROWTH AND CYTODIFFERENTIATION

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The purpose of this experiment was to determine whether or not DES effected normal cell growth and cytodifferentiation in the developing chick oviduct. DES, or diethylstilbesterol is a synthetically made hormone which has estrogenic activity similar to but greater than estrogen.

The experiment was carried out by injecting immature chicks with DES for a number of days. The chickens were sacrificed during the injection period at different intervals to look at cellular structure with the electron microscope. Cell number was determined by measuring DNA quantitatively using the di-phenylamine process.

The administration of DES to the immature chick resulted in prominent increases in oviduct size and weight, which were proportional to the amount of hormone given. The electron microscope was successful in demonstrating a marked effect on cytodifferentiation. Tubular, goblet and ciliated cells were all increased in number and size with ciliated cells being strikingly more prominent than normal.

Cell number was markedly increased early in the DES injection period but this trend did not occur throughout the entire injection period.

These experiments have shown that DES injection in the immature chick has a significant effect on cell growth and cytodifferentiation.

A COMPUTER SIMULATION OF THE PLASMA MEMBRANE'S TRANSPORT FUNCTIONS

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The purpose of this project was to create a computer simulation of the transport functions of plasma membranes. Two BASIC programs I created accomplish this: "Develop", which is used to design membranes by adding functional units to a lipid bilayer, and "Membrane", which simulates diffusion and facillitated diffusion across the membranes created with "Develop". The validation process involved in creating this simulation entailed four experiments investigating different aspects of transport. Using a phospholipid bilayer and three concentrations of lipid-soluble particles, Experiment #1 determined that the rate of diffusion is increased by an increase in concentration. Experiment #2 simulated the diffusion of lipid-soluble particles across membranes with extrinsic proteins; such proteins were found to decrease the rate of diffusion. Experiment #3 investigated diffusion through pores, which was found to occur much slower than diffusion directly across a lipid bilayer. Such diffusion can be facillitated, however, by an increase in the number of pores. Experiment #4 dealt with facillitated diffusion, which was demonstrated to occur the fastest. Furthermore, the experiment revealed that an increase in the number of carriers increases the particles' rate of diffusion. These simulations prove the programs are accurrate, and demonstrate their applications. Such simulations can be used to determine the quantitabive and qualatative changes needed to cure numerous human diseases caused by dysfunctions of the membrane. It is believed that scientists will eventually be able to perform "membrane-engineering"-the modification of living plasma membranes to cure the aliment.

#First Award - United States Navy/Office of Naval Research

A COMPARATIVE STUDY OF SLIM TEAS: SEROLOGICAL AND HISTOLOGICAL LEVELS IN THE BODY OF *MUS MUSCULUS*

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This investigation is an attempt to study the effect of slim teas in the elimination of fats in *Mus musculus*. Twelve pairs of mice were used to determine the effectiveness of slim teas on weight reduction. Groups of four mice were used. Group I (two females and two males) drank water and ate normal food serving as controls. Group II ate normal food and drank slim tea. Group III ate normal foot and drank Minasul. Group IV ate fatty foods and drank water. Group V ate fatty foods and drank slim tea. Group VI ate fatty foods and drank Minasul.

Slim teas were prepared with 5 ounces of boiling water and one or two bags of tea. Fatty foods consisted of pork meat and seafood cooked in animal oils.

This investigation has shown that slim teas are effective in removing fats from muscle tissue. Other areas studied revealed that while cholesterol levels remained steady in blood, triglicerides had a considerable increase. White and red blood cells were counted. RBC's increased but not to dangerous levels. Hemoglobin was not affected. Histological sections failed to indicate deposition of fat on them. These are being repeated.

HYPERGLYCEMIC RESEARCH: A POSSIBLE NEW ENZYMATIC METHOD FOR EARLY WARNING DETECTION OF JUVENILE DIABETES

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The BB/W diabetic prone rat, Rattus norvegicus albinicus, provides an ideal model for juvenile diabetes. Diabetes mellitus occurs spontaneously in approximately 50 percent of these individuals between 60 and 120 days of age. Beta cells of the pancreas cease to produce sufficient insulin to control blood glucose levels. Persons with diabetes are more susceptible to constriction of arteries, heart failure, kidney disease, glaucoma, and brain damage.

Amylase levels in humans with pancreatitis, or inflammation of the pancreas, are known to be above normal. It was hypothesized that a correlation may exist between amylase and glucose levels.

The author's objectives were to determine: (1) at what age glycosuria occurs in the BB/W diabetic rat; (2) amylase and glucose levels at various ages; and (3) if a correlation exists between earlier amylase levels and later glucose levels.

54 percent of the BB/W rats became diabetics, based on measures of blood and urine glucose and ketone levels, between age 79 and 86 days. High positive correlations were achieved as early as between amylase at age thirty and glucose on age sixty for all diabetic prone individuals a mean of 22 days before confirmation of diabetes. This suggests that early high amylase levels might indicate which individuals are most prone to developing diabetes. Such a warning system would allow the patient to begin immune prevention therapy earlier, and perhaps prevent the onset of diabetes.

Due to the correlation between early amylase and the onset of diabetes, the results suggest that amylase levels should be checked in humans during routine lab analysis. A data bank would be established and correlations determined.

#Second Award - General Motors ISEF

IMPROVING THE EFFICIENCY OF ARTIFICIAL HEARTS BY USING NON-PULSITILITY

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The purpose of my project is to develop an artificial heart that will negate the problem of thrombosis in pneumatic powered artificial hearts. I have observed that, to date, all clinical uses of the pneumatic powered artificial heart have caused thrombosis in the patients in which they were implanted. Much congestion and turbulence was observed in a pulsitile pump, which could be responsible for the formation of thrombosis. In a continual flow pump, there was no evidence of any turbulence. This could negate the problem of thrombosis. I proceeded to design and produce my own artificial heart. Through the study of the design of my heart, three major problems were found. (1) Incorrect pressure output on the pulmonary artery and aorta, (2) high shear stress on the red blood cells caused by the fanwheel, and (3) thrombosis occuring around the fan seal. I have proposed ideas that can correct each of these problems. This must be done before any bench testing can be done. A non-pulsitile flow pump eliminates many problems in pulsitile hearts. The best design to date is a centrifugal pump, which meets all the criteria for an artificial heart. In conclusion I have determined that a non-pulsitile flow blood pump can negate the problem of thrombosis in clinical uses of an artificial heart, and eliminate mechanical failures within the device.

*A STUDY OF BONE DENSITY IN COTURNIX COTURNIX JAPONICA

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This investigation was done in an effort to prove my hypothesis that calcium and exercise cause a noticeable increase in avian bone density. Experimentation was accomplished by raising 40 Japanese quail (Coturnix coturnix japonica). The birds were separated into four groups, which were: 200% calcium feed with exercise, 200% calcium feed and no exercise, regular feed with exercise, and the control group, regular feed with no exercise. I injected all birds with liquid Tetracycline, to label bone growth. The injections were administered on two occasions, ten days apart. After euthanizing the birds, I removed the right femur from each animal. I then cut sections and sanded them, processing the bone to be viewed under the polarizing microscope. Under the polarizing light, the Tetracycline labels fluoresced, and I photographed this phenomenon. Using a Hipad Digitizer and a bone morphometizing program with an IBM PC, I measured the bone cross sectional area, cortical cross sectional area, bone apposition in mm/day, and cortex thickness. My final summation of data proved, that as hypothesized, calcium and exercise caused a marked increase in bone density. Unexpectedly, I also found that the egg production was also greatly increased in the calcium and exercise group. Thus, it can be concluded that calcium and exercise cause an increase in bone density and egg production.

*First Award - American Medical Association
Second Award - United States Air Force
Fourth Award - General Motors ISEF

INVESTIGATION OF BIRTH DEFECTS INDUCED BY ACCUTANE

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Accutane is known to be a factor in birth defects in children of treated mothers. Upon the request of the author, no specific study of the inhibition of developmental processes was provided by the manufacturer or the Food and Drug Administration. The author has conducted a series of investigations to arrive at a hypothesis dealing with the mechanism of development effected. Experiments examined were 1) fatal birth defects occuring in the treated rabbit infants 2) skull development (directly related to neural crest migration and differention) and finally 3) a tissue analysis of ectomesenchyme.

Areas for further investigation were studied in depth, particularly the function of the extracellular matrix in cell migration (Harrol Slavkin's reports on mRNA transfer) and a comparison between the effects of Vitamin A and Accutane. Both the experiments and the background investigations seemed to demonstrate that Accutane effects the migration of neural crest cells. This research indicates that Accutane effects the components of the cell membrane interacting with the extracellular matrix, which theoretically guides the cells to various destinations.

THE EFFECTS OF CAFFEINE ON MICE

Alderman, Jennifer L., Manatee High School, Bradenton, FL 33505
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This is an experiment in feeding caffeine to mice to observe the changes in the behavior or lifestyle of the mice. The mice were fed varying amounts of caffeine through their water. They were observed twice daily and their behavior was noted. The experiment was conducted in two phases. A short term induction with a short term withdrawal and a long term induction followed by withdrawal. The entire experiment lasted nine weeks.

It was learned that not only did the caffeine appear to cause all the known effects it caused in humans but also that it can cause severe hair loss and supported the theory that ingesting too much caffeine can cause birth defects. The results of this experiment did seem to prove that caffeine has a tremendous effect on the behavior of mice.

THE EFFECTS OF CIGARETTES ON LIVING ORGANISMS

Cage, Christen L., Eastside High School, Gainesville, FL 32601
3464 N. W. 51st Ave., Gainesville, FL 32605

With the researcher's past studies she found that directly inhaled and second-hand smoke does kill Daphnia organisms. Another aspect of cigarette smoking is the residual waste left in the environment. The residual waste products have the same adverse effects as the directly inhaled and second-hand smoke.

To test this hypothesis, residual waste products from cigarettes were individually placed in water containing live Daphnia organisms. The Daphnia were then observed and the results recorded. Pictures of the Daphnia organisms were also taken.

NEUROFIBRILLARY PATHOLOGY OF ALZHEIMER'S DISEASE

Della Ventura, Cara S., Notre Dame Academy H.S., Staten Island, NY 10301; 267 Bryson Avenue, Staten Island, NY 10314.

No exhibit.

THE EFFECTS OF CITRIC ACID ON TEETH

Gibson, Nancy D., Bonneville High School, Ogden, Utah 84403
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Considering the growing awareness of total body fitness in America today, it can be assumed that many people would be interested in preventing dental decay. Therefore, considering the amount of citric acid in the American diet, the purpose of this project has been to analyze the affect of citric acid on teeth.

The experimental procedure involved the following steps. The teeth were baked at 250° for five hours in order to remove all moisture, providing a more accurate measurement of the weight of each tooth. A digital analytic balance was used for all measurements. Individual teeth were soaked in citric acid from ten different sources of varying concentrations for five weeks each. They were observed often to determine any change in appearance or condition. After five weeks, the teeth were baked to dehydrate, and reweighed to determine weight loss. The pH concentration of the citric acid was measured to determine the level of acidity.

Experimental results indicate that citric acid has a great affect on teeth. Changes occurred rapidly during the first week, and contributed greatly to the degree of decalcification of the tooth. One tooth lost 78% of it's weight! The amount of time the tooth is soaked, the fact that human saliva dilutes the acid, accounts for the variety of data collected during this study. Future study could involve a connection of heredity factors to a tooth resistance to decalcification.

PHENYLPROPANOLAMINE'S EFFECT ON YOUNG ADULT RAT DEVELOPMENT AND PHYSIOLOGY

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Magazine articles and health reports often warn of dangers and side effects to those that use Phenylpropanolamine.

Twenty-six female rats were divided into three groups at the age of five weeks. Each experimental group was given daily .25 ml injections of .1% and .5% Phenylpropanolamine--water solutions. The control group received injections of water. This procedure was done for a period of one month with weekly rat weights and metabolic rates tested. At the end of the experiment, the rats were sacrificed and dissected; and certain organs were examined, weighed, and prepared for making slides.

The organ weights varied very little. However, the experimental groups weighed slightly more than the control groups. Also, the spleens of the experimental groups were darker colored than that of the control group.

The rat weights of each group dropped after the experiment began, but they all rebounded after the first week. This was probably caused by the rats becoming accustomed to the experiment being performed on them. All groups lost or gained weight in the same sequence.

The metabolism of the control group rose, leveled off, and fell. The .5% group was similar to this also. However, the metabolism of the .1% group varied up and down.

Because of the small difference in rat body and organ weights and their wide range of metabolic rates, it cannot be said for sure if Phenylpropanolamine affects young adult rat development and physiology.

*EFFECT OF MOMORDICA CHARANTIA LEAF EXTRACT OF TRICHOPHYTON EQUINUM, EPIDERMOPHYTON FLOCCOSUM AND TRICHOPHYTON PEDIS IN "VITRO" AND "VIVO" IN THE HOMO SAPIENS

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This study concerns the leaf effect of the MOMORDICA charantia plant. This plant is abundant in Puerto Rican vegetation, known as "cundeamor". Various concentrations were used in the previous research on the effect of this plant on the *Trichophyton rubrum* fungus and on psoriasis. It was found that in the proportion 3 to 1 it is efective.
This proportion of the plant extract will be used for the control or elimination of skin fungi in the *Homo Sapiens*. In the surveys were carried out, of the 21% of humans with skin diseases, 76% of these are caused by fungi. On the basis of this survey, the three most predominat in humans, were chosen for the experimental phase. The *Trichophyton equinum*, *Epidermophyton floccsum* and *Trichophyton pedis* prevail the experimental phase. The "vitro" method was primarily used in which two colonies of each fungus in the agar environment will be formed; one control and the other experimental phase, applying the extract daily. After the laboratory results of the "vitro" phase, we will begin the "vivo" phase by the direct application to the fungus on different human skin. As a result of the leaf extract of the *Momordica charantia* plant, the plant serves as an efficient antifungi agent, eliminating the *Trichophyton equinum*, *Epidermophyton floccosum* and *Trichophyton pedis* fungi. A chemical analysis demonstrated a high percentage of calcium and p. p. m. of zinc. The *Momordica Charantia* plant has proved to be a plant with dermatophysical properties.

*Fourth Award - General Motors ISEF

A COMPARISON OF THE OXYGENATION CAPACITY OF NATURAL AND ARTIFICIAL BLOOD AFTER CARBON MONOXIDE SATURATION

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The purpose of my project is to determine if normal human red blood cells are more efficient than hemoglobin solution and perfluorochemical emulsions in carrying oxygen to the tissues after carbon monoxide saturation.
I tested my blood, a normal synthetic blood control, and a hemoglobin solution. I placed the blood samples in three separate petri dishes. The dishes were then placed in a jar with a charcoal briquette burning under all the samples. After being exposed and fully saturated with carbon monoxide for over 24 hours, I used the Blood Gas Analyzer and the Co-Oximeter to determine the percentage of oxygen and carbon monoxide present in the samples. Each sample was then placed in the tonometer for five minutes to be saturated with oxygen. After being saturated with oxygen, a second reading was taken to determine the remaining percentage of carbon monoxide.
From the readings taken, I found that the perfluorochemical emulsion would be the most efficient therapy for carbon monoxide poisoning. It has a greater affinity for oxygen while releasing the carbonmonoxide. The hemoglobin solution would bind easily with the oxygen but would not release the carbon monoxide as efficiently. The human blood, on the other hand, would bind with the oxygen but would not release the carbon monoxide.

INHIBITION OF TUMOR NEOVASCULARIZATION

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1908 72nd Street N.W., Bradenton, FL 33529

The growth of the capillaries toward a tumor is the major step in the development of the tumor. In this research the inhibition of the growth of those capillaries was attempted. Using the procedure in a Science magazine (221:1185) the extract was derived that should have inhibited the growth of capillaries toward the tumor.

This extract was incorporated into Ethelyene vinyle acetate copolymer pellets that released 1 um of biologically active molecules per day. In the tissue between the abdominal wall and the skin of the rat, three pellets of the extract were implanted. For control rats, pellets that did not contain extract were implanted. Along with the pellets a rat breast cancer (MT-F7) was also implanted.

The growth of the capillaries and the tumor was monitored for a period of 15 days. In the first 10 days the tumor of the experimental rats grew five times as fast as the control and the area was more vascularized. For the next 6 days the experimental rat tumors were larger than those of the control, but the vascularization was the same.

As a result the growth of the capillaries was not inhibited but enhanced by the shark cartilage extract. The effect of the extract on the growth of the tumor, due to its effect on the capillaries, was shown to be significant.

#MALARIA VECTORS: EIGHT NEW SPECIES IMPLICATED

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Identification of the species of Anopheles mosquito that are infected with the sporozoite stage of one of the 4 human malaria species is key to understanding the dynamics of malaria transmission in a particular geographical area. Recent production of monoclonal antibodies specific to the major surface coat proteins of sporozoites of 2 human malaria species, Plasmodium vivax and P. falciparum, has made possible the development of two enzyme-linked immunosorbent assays (ELISAs) that detect sporozoites in mosquitoes. In this study, a mathematical method for estimating numbers of sporozoites in each infected mosquito was developed, expanding the ELISA from simply a qualitative test for the presence of sporozoites to a quantitative test for the numbers of sporozoites in individual mosquitoes. ELISA tests on 13 Anopheles species from refugee camps on the Thai-Kampuchean border detected malaria infections in 10 species. Only 2 of these species have been previously recognized as important malaria vectors in this region of Southeast Asia. The ELISA test results raise the suspicion that species other than the 2 known primary vectors play an important role in malaria transmission in the Thai-Kampuchean refugee camps. Confirmation of the vector status of the 8 newly-implicated species will require further investigations.

#First Award - American Veterinary Medical Association
Third Award - Entomological Society of America
Third Award - General Motors ISEF

#CRITICAL ROLE OF CIGARETTE SMOKING IN THE PRODUCTION OF MYOCARDIAL INFARCTION AND RELATED COMPLICATIONS - A 2 YR. STUDY

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11159 Cindy Dr., Brooksville, Fl. 33512

Coronary heart attacks appear to be the commonest cause of deaths in USA, according to American Heart Association. The purpose of this research project was to determine the importance of chronic cigarette smoking in the production of acute myocardial infarction (heart attacks) and related complications. It was hypothesized that cigareete smoking would play a significant role in the development of heart attacks. Ninety consecutive cases of heart attacks admitted to coronary care units of two hospitals in Hernando County, were reviewed and data analyzed. The cardiologist in charge of the cases was questioned and some of the survivors were personally interviewed. Cardiac function- cardiac wall motion and left ventricular ejection farction- was evaluated by cardiac ultrasound- a real time two dimensional echcardiographic system- in 21 patients. The conclusions are:

1. 70% of the victims were smokers, suggesting an increased risk for heart attacks ($P = < .001$)

2. Heart attacks occurred at earlier ages in smokers.

3. Two major complications of acute myocardial infarction, Ventricular Tachycardia ($P = \leqslant .05$) and Ventricular Fibrillation (P = NS) were more prevalent in the smokers.

4. Significant decrease in cardiac funtion as evidenced by a decrease in left ventricular ejection farction ($P = \leqslant .05$) occurred more frequently in smokers after heart attacks.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society

SIMILARITIES OF PEOPLE WITH DIABETES USING DERMATOGLYPHICS

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I believe that diabetes may be predicted by studying a person's fingerprints. Fingerprints are a trait, they would, therefore, be controlled by a person's genes. Diabetes has a likeness to fingerprints in the sense that diabetes generally is believed to be an hereditary disease, therefore being controlled by the genes. If the two traits have some type of correlation, then diabetes may be predicted through the use of dermatoglyphics, the study of fingerprints.

Dermatoglyphics was the method of study, which I used to try to discern the resemblances in the following categories: 1)"Type of Fingerprint", 2)"Ridge Count", 3)"Other". When comparing the fingerprints, each finger of one subject was compared to all of the other samples of fingerprints of the same type (R1 to R1).

In conclusion, I found that by using dermatoglyphics there is a probability that diabetes may be predicted, with a compilation of more data concerning this topic.

#ANALYSIS OF SERUM OPSONIC ACTIVITY IN NEONATES AND ADULTS: A MICROSYSTEM BASED UPON NEUTROPHIL OXIDATIVE METABOLISM

Sebring, Page, St. Pius X H.S., Albuquerque, NM 87110
3818 La Hacienda Dr. NE, Albuquerque, NM 87110

This is a presentation of studies done to establish a reliable system for the determination of serum opsonic activity against bacterial pathogens in infants, with the proposed application of this system to compare the opsonic activity of formula-fed and breast-fed infants' sera.

Experiments consisted of examining the opsonic activity of normal adult serum and plasma against killed *Staphylococcus aureus* and *E.coli* strains, as determined by superoxide anion release by neutrophils in response to bacteria opsonized in dilutions of the opsonin. *S. aureus* and one *E. coli* strain (*E. coli* K-12) were found to opsonize well in normal serum and plasma. The opsonic activity of cord blood serum to these organisms was decreased. The degree of opsonization of *S. aureus* by heat-inactivated adult and cord serum was decreased as compared to non-heat-inactivated sera; the opsonic activity of non-heat-inactivated cord serum was decreased. The opsonic activity of human milk to the organisms was comparable to that of adult serum.

The consistency of the results from all experiments done indicate that this system is reliable for indicating serum opsonic activity; the use of a serum titration curve is useful for indicating the degree of this activity in normal as compared to neonatal serum, and neutrophil oxidative burst in response to these degrees of opsonization is a good indicator of this opsonic activity.

#First Award - General Motors ISEF

IMMUNE EVALUATION OF HOMOHARRINGITONINE (HHT)

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Homoharringitonine (HHT) is a cephalotaxine ester from the *Cephalotaxus harrigitonia* and *Cephalotaxus fortunei* evergreen trees that are widely distributed in China. HHT is currently under clinical investigation for treatment of acute non-lymphoblastic leukemias. The project was designed to determine HHT is an immunosuppressive antitumor agent. Concentrations ranging from 1ug/ml to .0001ug/ml of HHT were cultured with human peripheral lymphocytes *in vitro*. Lymphocytes were isolated from the blood and stimulated with mitogen Phytohemaggulitinin (PHA) in culture. After inducing the lymphocytes to grow with the mitogen, HHT was added to the culture. Results show that all concentrations of HHT are inhibitory to lymphocyte proliferation without mitogenic stimulation. After mitogenic stimulation (PHA 3,4, and 5), concentrations .01ug/ml, .001ug/ml and .0001ug/ml of HHT with mitogenic stimulation stimulate lymphocyte proliferation to cell population, equivalent to or higher than the cell population with mitogenic stimulation alone. Data shows a correlation between *in vivo* concentration and *in vitro* concentrations. Results imply that low dose daily adminstration is preferable to bolus IV injection.

#EFFECT OF D-GLUCOSE ON CARDIOVASCULAR RESPONSES TO STRESS: THE FINAL PHASE OF A 6 YEAR STUDY

Rooney, John Garry Jr., Rockledge H.S., Rockledge, Fl. 32955
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Over the past five years, the hypothesis that D-glucose increases cardiovascular responses to stress has been tested. Statistics show that such increases occur significantly in Systolic Blood Pressure, Pulse Pressure, Heart Rate, and Double Product. The final phase now is to determine the cause of such significant increases in blood pressure and heart rate after the ingestion of D-glucose by testing the formulated theory: Glucose ingestion → Increased flow of blood to gut → Increased volume of blood to gut → Decreased blood volume elsewhere → Decreased arterial pressure → Increased Pulse Pressure (Blood Pressure change) & Heart Rate.

Fifteen male adolescents who have no known history of diabetes, hypoglycemia, or hypertension were tested after a 10-hour fast. Blood pressure and heart rate were measured in the supine and standing positions (baseline). Each subject was given dextrose 100 Gms./300 ml. to drink. After 45 minutes, blood pressure and heart rate were measured in the supine and standing positions (post-glucose). Measurements also included pulse pressure and double product.

Data was analyzed by using the analysis of variance (ANOVA) technique. The analysis showed that all five groups studied (SBP, DBP, HR, PP, DP) rejected the null hypothesis at the .005 level of significance. This means that the researcher is 99.5% confident that the stated hypothesis (D-glucose ingestion will cause a blood pull to the gut, which, in turn, will cause an increase in pulse pressure and heart rate) is correct.

#Third Award - General Motors ISEF

ANTIBIOTICS USED IN THE PROMOTION OF GROWTH

**Hershberger, Peter G., The Canterbury H.S., Fort Wayne, IN 46804;
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The purpose of this project was to see if animals, fed a consistent diet of subtherapeutic amounts of antibiotics, would breed bacterial strains resistant to antibiotics.

Results from this investigation indicate that if animals, receiving too high a level of antibiotics while trying to promote growth, become ill, the bacteria will become immune to the antibiotic.

The animals used in this study all reacted similarly to the antibiotics. However, the three different antibiotics did promote different growth rates in the animals.

It is true that antibiotics promote growth in animals. However, this growth is not always proportional to the amount of antibiotics fed to the animals. Once you reach a certain level the antibiotics no longer have an affect on the animal's size.

DOES A MOTHER'S MILK AFFECT IMMUNITY?

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Hypothesis: When the concentration of immunoglobulin A (IgA) in breast fed teens and the concentration of IgA in formula fed teens are compared, there should be a higher concentration of IgA in the breast fed teens. There should also be fewer allergies in the breast fed teens.

Procedures: Questionnaires and permission forms were distributed. Saliva samples were then gathered and tested for the amount of IgA in each one. The breast fed participants' results were compared to the formula fed participants'. The results were then recorded and graphed.

Results: Participants with a ring diameter of 3.0 mm had an IgA concentration of 15 mg/100ml. Participants with a ring diameter of 3.5 mm had an IgA concentration of 28 mg/100 ml. Participants with a ring diameter of 4.0 mm had an IgA concentration of 39 mg/100ml. Two of the three formula fed subjects had allergies (66%). Five of the nineteen breast fed subjects had allergies (26%).

Conclusions: From the results of this project, it is now known that a larger precipitin ring diameter results in a higher concentration of IgA. Conclusions to support the hypothesis could not be drawn from the results. From the information gathered, breast fed and formula fed teens do not have a noticeable difference in concentration of IgA in their saliva samples. If this project were to be continued more samples would be gathered from an age group ranging from six weeks to six months old for more statistically relevant results.

THE BACTERICIDAL AND BACTERIOSTATIC PROPERTIES OF MOUTHWASHES AND DENTIFRICES

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The purpose of my project is to compare antiseptic mouthwashes and dentifrices on the basis of their bactericidal and bacteriostatic properties. Agar plate tests, tests for bacteriostatic substances, pH tests, phenol coefficient tests, saliva tests and before and after use tests were run on each of five commercially sold antiseptic mouthwashes and seven toothpastes. Agar plate tests check the potency of bactericidal agents. Tests for bacteriostatic substances indicate if the antiseptic or toothpaste is inhibitory to bacteria without killing it. Phenol coefficient tests compare antiseptics with phenol which is used as the standard or control. PH tests were used simply as a means of checking acidity to insure that the product has no toxic effects. Saliva tests were done to exhibit the effects of antiseptic mouthwashes and toothpastes have on saliva cultures. Before and after use tests demonstrate the ability of the antiseptic mouthwash or toothpaste to act upon actual mouth cultures. Smears of the plates used in these tests indicate the types of bacteria the product is effective in killing. The results of these tests point to Scope as the most potent antiseptic mouthwash, and Aim as the most effective bactericidal and bacteriostatic dentifrice of those tested.

THE COUNTERACTION OF ETHIONINE-INDUCED LIVER CANCER BY DL-METHIONINE

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This study was undertaken to determine the effects of methionine on ethionine-induced hepatic carcinogenesis. To evaluate the role of the methyl cycle, for which methionine is responsible, in the counteraction of this process, other compounds involved in the methyl cycle were utilized. It was hypothesized that methionine would limit the carcinogenic activity induced by ethionine, glycine would limit the protective effect of methionine, and cysteine would have a negligible effect on the activity of ethionine.

Five groups of Wistar rats were maintained on diets of ethionine, ethionine+methionine, ethionine+glycine, ethionine+methionine+glycine and ethionine+cysteine, respectively. These rats were weighed and examined bi-weekly for four months. At this time 3 animals from each group were sacrificed. The liver of each rat was grossly examined, weighed and removed. The livers were then homogenized, centrifuged, and tested for gamma-glutamyl transpeptidase (GGTP), an enzyme which is present during carcinogenesis.

The group maintained on ethionine demonstrated, both grossly, by the presence of multiple hyperplastic nodules and cirrhosis, and enzymatically, by the elevated levels of GGTP, 100% incidence of cancer. Those rats supplemented with methionine in addition to the carcinogen ethionine demonstrated no incidence of cancer. Glycine, when supplemented in addition to methionine, limited the protective effect of methionine. Cysteine exacerbated the effects of ethionine. The effects of each of these compounds confirm the importance of the methyl cycle in the counteraction of ethionine carcinogenesis and the significance of methionine as a potential preventive for cancer in general.

#Third Award - General Motors ISEF

THE EFFECTS OF CHYMOPAPAIN AND OTHER NATURAL DERIVATIVES IN THE TREATMENT OF LUMBAR DISC PROBLEMS

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Do natural enzymes have the same effect in the treatment of discs as chymopapain?

Obtain several samples of sheep vertebra, each containing a disc. Disect any remaining meat, as cleanly as possible, off the samples. Crush approximately one-fourth of a fresh pineapple in a blender and filter the pure juice through a Buchner funnel. Check the flexibility of the vertebra and record. Inject three cc. of the juice into one sample. Place in a plastic bag, seal, and refrigerate. Do the same for an uninjected sample which will serve as a control. Check and record flexibility for a period of ten days.

The flexibility increased rapidly for the first eight days, and then plateaued.

Under existing conditions I proved my hypothesis; Natural enzymes will have the same basic effect on the breakdown of cartilage as does chymopapain; to be true.

# MICROWAVE VS. CHEMICAL STERILIZATION

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The purpose of Experiment No. 1 is to determine the effectiveness of the controversial microwave sterilization process against the conventional chemical process.

The purpose of Experiment No. 2 is to determine the effect of microwaves on different denture materials.

The procedure for Ex. No. 1, test 1, is to submerge a denture into an inoculated broth culture for 24 hrs. Remove denture and place into an autoclave bag. Place bag into microwave and run for the designated time. Place denture into sterile nutrient broth. Incubate for 24 hrs. Streak blood agar plates.

The procedure for Ex. No. 1, test 2, is to repeat step 1 in test 1. Remove denture and place into disinfectant for the designated time. Repeat the last three steps in Ex. No. 1, test 1.

The procedure for Ex. No. 2 is to place the denture materials into the microwave oven and run for the designated time. Remove and check for dimensional changes.

This study has shown that the sterilization of viruses, bacteria, and spore forms can not be done by microwaves alone.

Germicidal was the most effective chemical disinfectant. The least effective chemical disinfectant was Cidex 7.

The chemical sterilization process should be used over the microwave sterilization process because of its great effectiveness in sterilization and the microwave sterilization process' inability to do so.

The microwave oven can be used on microwave transparent materials (acrylic) but microwaves can not be used on microwave absorbent materials (luxene) due to the warpage caused by them.

#Honorable Mention - Eastman Kodak Company

"THE INFLUENCE OF VARIOUS THYMOSIN$_{a-1}$ PEPTIDES ON REGENERATION IN RANA CATESBIANA"

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Regenerative capabilities have long been observed in lower vertebrates such as salamanders and tadpoles.

The objective of this research was to determine if various Thymosin$_{a-1}$ peptides might influence regeneration in tadpoles of Rana catesbiana.

Tadpoles were anesthetized and one centimeter was removed from their tails. These tadpoles were then placed in different experimental chambers containing a 10% Holfreter's solution supplemented with the following amino acid sequences of the Thymosin$_{a-1}$ chain: 1) Val-Glu-Glu-Ala-Glu 2) Glu-Ala-Glu-Asp 3) Glu-Ala-Glu 4) Lys-Glu-Glu-Ala-Glu 5) Control (10% Holfreters solution).

The time and progress of their regeneration were observed under these conditions to ascertain the optimal regenerative rate and peptide concentration. This was achieved under the influence of 2ppm of the Lys-Glu-Glu-Ala-Glu peptide chain.

Antisense DNA Inhibition of Leukemia Cell Growth

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The c-myc oncogene, cancer causing sequence of DNA in the human nucleus, encodes a protein, p65, that is found in abundance in lymphomic leukemia, Burkitt's Lymphoma, and other forms of cancer. The increased amount of protein is the result of a higher rate of transcription, the formation of mRNA, and may be the cause of the cancer. If the translation, formation of the protein according to the sequence of the mRNA, could be inhibited, then the cell growth rate may decrease. An oligodeoxynucleotide, short chain of DNA, that is complementary to the initiation codon and following four codons should bind to the mRNA and inhibit protein production. HL60 human leukemia cells, which greatly overproduce c-myc, were the test cells. Increasing μM concentrations of the DNA chain were introduced to the cells in culture and counted and checked for viability after five days. A concentration of about 3 μM DNA inhibited about 50% of the proliferation. A concentration of 6 μM inhibited cell proliferation 100% without decreased viability. The concentrations between yielded confirming results which were graphed in an line. Two control chains of DNA with a different, noncomplementary, sequence was introduced to the cells and yielded no inhibition. Experiments with DMSO decreased cell growth and increased rate of differentiation. Combination experiments with DMSO and the DNA chain indicated a greater combined effect on proliferation inhibition, but not on differentiation. Further repetition of previous experiments have and western blots should reconfirm this data. These results indicate the possibility of decreasing the production of a specified protein with the introduction of the antisense chain of DNA, a method that could be applied to several diseases.

#First Award - United States Army

THE EFFECT OF BEE TOXIN (APIS MELLIFERA) ON RHEUMATOID ARTHRITIS.

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Rheumatoid arthritis is a disease that affects the joints of human beings. It has been treated with several anti-inflamatory and pain relieving drugs that only have temporary effects. The effect of Apis mellifera toxin (venom) on rheumatoid arthritis in Rattus norvegicus was invetigated in this work. The group of components that intervined were also identified. A relief and a possible cure for the disease was discovered.

Rheumatoid arthritis was provoked on Rattus norvegicus using the Freund's Adjuvant method. Toxin was separated into a supernatant and a precipitate fraction by centrifugation. Heated and un-heated supernatant and precipitate fractions were injected subcutaneously at the base of the rat's tail on a 0.1cc /200 gms proportion of the animal weight. Using X-rays we found that only rats injected with non-heated supernatant were alliviated. Thus non-heated supernatant was the one responsible for mitigating or diminishing the degree of rheumatoid arthritis.

Measurements of circumference of posterior joints showed the unheated supernatant fraction reduced the degree of rheumatoid arthritis on affected rats. Temperature measurements and pathological examination of tarsal joints indicated that the moderately severe synovitis induced by Freund's Adjuvant method had been reduced to a minimal synovitis by the bee venom fraction of 10,000 daltons or less.

#First Award - Eastman Kodak Company
Fourth Award - General Motors ISEF

THE TOXICITY OF PROPANOLOL HYDROCHLORIDE ON THE MORPHOLOGY OF THE GALLUS GALLUS EMBRYO

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Today, most women with cardiovascular disorders like hypertension, angina pectoris and arrythmias during pregnancy are given the drug Inderal. To date, there have been no studies conducted on the effect of Inderal on the human fetus. With this in mind and the concern over a family problem of hypertension and arrythmia led to the development of this project testing the toxicity of Inderal on the Gallus gallus embryo.

Fertilized eggs were collected and classified into six groups according to their masses and marked with ID numbers. The eggs were then placed into an incubator set at 37°C. On the 6th day of incubation the embryos were innoculated with different concentrations of Inderal according to their groups. The eggs were returned to the incubator until the 17th day. This study was completed in 5 phases reducing the dosage of Inderal in each phase to establish its toxicity. A total of 540 eggs were used.

During each phase, the eggs were opened on the 17th day. The embryos were examined and compared by using linear measurements and mass along with the mass of vital organs, blood smears and tissue sections of heart, liver, lungs, kidneys and brain and blood gas chromatography. The data was compared and analyzed and a conclusion was reached.

Analysis of the data of the Inderal innoculated embryos revealed morphological changes during development. The blood smears revealed varying sizes and shapes of nucleated RBC with nucleoli indicative of immaturity. Brain tissue exhibited necrosis and degeneration. Heart and liver tissue showed degeneration and immaturity of cells. Lung tissue revealed constricted alveoli with the increase of Inderal. Blood gas chromatography studies showed 680mg/l of propanolol present comapred to 50-100mg/l. The embryo size and development was greatly reduced as the amount of Inderal increased.

From the studies done, it can be stated that Inderal has a toxic effect on the developing Gallus gallus embryo.

TUMOR CELLS IN PROCESS OF DEGENERATION DEVELOP ANTIPROLIFERATIVE CAPACITY

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This investigation attempts to determine the effect of homogenates of tumor cells on young cell cultures of the same tumor. It is suggested that these old tumor cells produce a substance that affects the development and growth of young cells of the same tumor.

According to the time that the cells were going to be allowed to grow old, they were separated in groups at environmental temperature, during the indicated time. Once the cells had grown old, the cultures were homogenized and frozen until they were to be processed. They were added in different dilutions to cultures of young cells and to the controls (fibroblasts of chick embryon).

The homogenates showed titers that oscillated from a minimum of 1/10 at 96 hours to a maximum of 1/40 at 240 hours. No change was observed in the normal cells.

These titers suggest that during this time no living cell was detected and that substances were accumulated that turned out to be toxic to young cells of the same tumor.

#MORPHOLOGICAL STUDY OF CHICKEN EMBRYOS EXPOSED TO ASPARTAME (NUTRASWEET) COMPONENTS

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Aspartame, an alternative sweetner which readily breaks down into its components when ingested, is found in many food products. However, its safety is still being questioned. Therefore, the purpose of this project was to investigate the effects of the three components: phenylalanine, aspartic acid and methyl alcohol, upon a rapidly developing organism, the chicken embryo.

On the seventh day of incubation, fertile chicken eggs were exposed to the chemicals at three exposure sites: injection into the yolk, into the air sac, and placement onto the membrane. Dosage amounts for single and combination component exposures were based on the FDA standard of 30 mg per Kg of body weight as the maximum safe level for daily consumption of aspartame. For combination component exposures, a double amount of the FDA value was also tested. Control dosages were measured throughout experimentation. On the seventeenth day of development, incubation was terminated. The embryo was removed from the egg and ten different body measurements were recorded. Heart and liver examinations were also made to determine any abnormalities.

More than 100 eggs were examined and the component exposure resulted in adverse effects upon the embryos' morphological structure. These effects included reduction of embryo mass (when corrected for initial egg size). All observations were validated by data gathering and statistical analysis, using the Spearman correlation coefficient and chi square methods. This project mandates further research on the effect of aspartame components on other developing organisms. Such investigations should also examine possible alterations in neurological characteristics.

#Third Award - General Motors ISEF

GENETIC AND PHYSICAL ANALYSIS OF LATENT HERPES VIRUS TO ACYCLOGUANOSINE

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Through the research done in antiviral chemotherapy, approximately twelve drugs are commonly used to treat herpes virus infections in humans. Even though these drugs inhibit viral repliction, the problem of recurrent infections persists.

The main purpose of my research was to induce viral latency from a herpes virus infection. The host cells used in this study were African Green Monkey Kidney cells (VERO cells). The virus used was IBR (Infectious Bovine Rhinotracheitis) a herpes virus in cattle. The drug used was Acyclovir (ACV) which is the most promising drug available for human use.

Concentrations of 100 mcg/ml to 2000 mcg/ml of ACV were effective in the inhibition of viral replication. Concentrations of 50 mcg/ml to 0.3 mcg/ml of ACV inhibited the virus, but did not terminate viral replication effectively. Concentrations up to 2000 mcg/ml of ACV showed no toxicity to the VERO cells.

A series of procedures were designed to induce viral latency which is a combination of techniques used in this research. Latency was found in the second passage of VERO cells at the ACV concentration of 100 mcg/ml. There were no plaques in the first passage of VERO cells at the same concentration. Therefore, the appearance of plaques in the second passage verified latency.

In this study, latency has been found to reduce the effectiveness of antiviral drugs.

#Fourth Award - General Motors ISEF

ROLE OF B. OLERACEA POLAR CONSTITUENTS AS A POSSIBLE INHIBITORY AGENT ON E.A.T. TUMOR: PHARMACOLOGICAL AND TOXICOLOGICAL ASSAYS

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The green vegetable, Brassica oleracea var botrytis commonly known as broccoli was used in the inhibition of cancerous tumors. The investigation was done in different phase, the pharmacological levels present on Brassica oleracea var botrytis extracts were determined using the Brine Shrimp Bioassays. The decoction (water extract) dry plant and the ethanolic extract (green plant) had the higher pharmacological levels.

On the second phase, five groups of three Balb-C mice, were treated with several substances to serve as controls. Mice treated with distilled water, ethanolic traces, B. oleracea decoction and B. oleracea ethanolic extract did not show any effects in the different assays. The blood cell count and the histological study failed to reveal any change in the number of white cells or any damage to the internal tissue.

On the third phase, the decoction and the ethanolic extract were used to confirm the anticarcinogenic properties of B. oleracea.

The EAT control group revealed an increase on the weight of the three mice. The mice infected with EAT and treated with B. oleracea extracts had a continued standard weight. The hematological assays demonstrated an important increase in the number of neutrophils (antibodies).

The preliminary results of the histological study revealed a difference in damage to the internal tissues between the control group and the experimentals treated with B. oleracea.

#First Award - General Motors ISEF

#EXTRACTION AND IN VITRO EVALUATION OF POTENTIAL ANTICANCER AGENTS FROM FUNGI

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The purpose of this work was to isolate preferentially solid tumor active substances from fungi. The need for such agents stems from the fact that most antitumor drugs available for clinical use are effective against leukemias and lymphomas, but are of little use against solid tumors. Fungi were isolated from soil and plant tissue samples collected from a variety of geographic areas. They were cultivated in mycological broth and cytotoxic products were extracted using ethanol from both the mycelia of the fungi and the broths in which they were grown. This is a new approach, since related work has involved the extraction of products only from the broths. The products were tested in the Disk-Diffusion Drug Discovery Assay, developed by Dr. T. H. Corbett (Wayne State University). This is an in Vitro assay involving mouse tumor cells and is designed for the selection of substances having preferential activity against solid tumors over leukemias. One-hundred and ninety-two products were extracted and tested against five different tumors, both solid and leukemic. Seventeen percent were active against one or more tumors and six percent showed preferential solid tumor activity. Two of these will be tested in Vivo. The majority of the active products were mycelial extracts as opposed to broth extracts. These results indicate that preferentially solid tumor active agents do exist, and that some fungi are producing them.

#Second Award - General Motors ISEF

#ENZYME IMMUNOASSAY FOR DETECTION OF Candida albicans IN HUMAN SERUM

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Candida albicans is a yeast like fungus that grows on mucous membranes. Current assays for detection of systemic Candidiasis are inadequate. Consequently there is a significant increase in the mortality of patients with surpressed immune response. An enzyme immunoassay has been developed using polyclonal and hybridoma antibodies that can detect increased levels of Candida antigen in sera from patients proven to have systemic, disseminated and/or invasive Candidiasis compared to sera from healthy individuals.

Hybridoma antibodies have been prepared by fusion of SP2/0 melonoma cells with spleen cells from Candida-immunized Balb/c mice. The hybridoma supernates, containing antibodies to Candida have been evaluated by the hemagglutination assay and their ability to precipitate in gel diffusion. 379 hybridoma producing specific antibodies to Candida antigen have been developed. The hybridomas have proven to produce specific antibodies to Candida albicans and have been used to produce monoclonal antibodies. The monoclonal antibodies will be characterized and used in the enzyme immunoassay to determine if the sensitivity and specificity can be increased. The hybridoma antibodies were used in the enzyme immunoassay and produced a better sensitivity than when the polyclonal was attached to the solid phase. Sensitivity is the ability to differentiate low levels compared to high levels of Candida albicans in an individual's body. The development of the enzyme immunoassay is in great need due to Candidiasis occuring in cancer patients, AIDS patients, individuals receiving broad-spectrum antibiotics and intravenous hyperalimentation.

#Third Award - General Motors ISEF

#THE DEVELOPMENT OF AN ULTRAVIOLET (A) SENSITIVE MEASURING DEVICE TO TEST THE EFFICACY OF AN ULTRAVIOLET (A) SUN BLOCKER: A CONJUGATED CHEMICAL AND BACTERIAL SYSTEM

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It has been shown in my previous study (1985) that bacterial growth and/or suppression could be used as a sensitive marker for the study of Ultraviolet B light penetration through sunscreens. In this present experiment, designed to test the efficacy of a new sun blocker (Burn-Off 16) against Ultraviolet A light, preliminary testing showed that the UVA energy source, by itself, did not inhibit the bacteria (Staphylococcal epidermidis) even after 30 minutes of light exposure. In light of this finding, it was essential to develop a new bacterial measuring system before the new sun blocker could be analyzed as to its effectiveness against UVA penetration.

It was hypothesized that if the UVA sensitive chemical, Psoralen, could be conjugated to the DNA of the bacteria (as it is known to do in the human cell) and then the bacterial system exposed to UVA light, the resulting photoreactive chemical might suppress the bacteria. If this could be established, then the new conjugated bacterial system could be utilized as a sensitive measuring tool to determine UVA light penetration through a sunscreen or sunblock.

My findings proved the hypothesis to be correct, resulting in an effective UVA sensitive measuring system which showed that the UVA blocker was beneficial.

Thus, this reproducible laboratory model can be utilized for testing UVA sun blockers and possibly for other future medical applications such as: rendering tumors or infectious organisms more sensitive to treatment.

#First Award - General Motors ISEF

THE ROLE OF BETA-ADRENERGIC RECEPTORS IN LEUKEMIA

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Beta Adrenergic receptors on Leukemia (U-937) Monocyte-like, Histiocytic lymphoma, human form, American Type Culture Collection were assessed, in vitro, using (I 125) (-)- Iodocyanpinodol binding and 3H -Tymidine assay. The white blood cells were tested for the number of Beta-Adrenergic receptors and the Beta-Adrenergic affinity for agonists, measured by the competition of (I 125) (-) Iodocyanpinodol binding by -Isoproterenol. The affinity was not significantly reduced with the addition of Guanosine triphosphate, a chemical which transforms receptic affinity to low affinity, thus indicating that the Beta-Adrenergic receptors on this line of Leukemia cells have low affinity. The comparision of specific binding of the cell line with normal mononeucleocyte indicates low receptor density. This is consistent with the results of high non-specific binding (50-70% veus approximately 10% in normal mononeucleocytes). The conclusion is this line of leukemia cells have low affinity and few receptors. After determining the low affinity of the Beta-Adrenergic receptors, the receptor ternary complex was assessed by testing the mitrogenesis of the leukemia cells using 3H-Tymidine assay. The cells were treated with either cyclic AMP, isoproteronol, or cholera toxin. The decrease of 72% of cells treated with cyclic AMP coinsided with Oppenheim's study (9). The difference between the percentages of decreased cell mitogenesis between cyclic AMP and isoproteronol (72% to 16%) indicates that the functioning of the Beta-Adrenergic receptors are in low-affinity states and/or few in number. The percentage decrease in the cells treated with cholera toxin was 30% thus indicating that this line of cells do not have G-proteins, due to the fact that high concentration of the toxin kill about that percentage.

LACTATE DEHYDROGENASE ISOENZYMES IN CHILDHOOD ACUTE LYMPHOBLASTIC LEUKEMIA

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It is known that the LDH enzyme levels increase in the serum of patients with acute lymphoblastic leukemia (ALL), as the white blood cell count increases. Bone-marrow, peripheral blood and serum samples were taken from twenty-three children with acute lymphoblastic leukemia (ALL), and sera from normal children were obtained. Electrophoresis for the Lactic Dehydrogenase enzyme resulted in its migration into five distinct isoenzymes labeled LDH-1, LDH-2, LDH-3, LDH-4 and LDH-5. The isoenzymes formed bands on the electrophoresis medium which were scanned for their relative intensities. The results indicate that differences occur between normal and leukemia LDH isoenzyme levels. Also discovered was that the LDH isoenzyme patterns in ALL sera resembled the patterns of the bone marrow and peripheral blood. Therefore, there must be a mechanism in ALL that causes the LDH enzyme to enter the serum from the blood tissue. In addition, the LDH isoenzyme pattern may contribute initial clinical information concerning ALL.

THE EFFECTS OF ALUMINUM CONCENTRATIONS ON GALLUS DOMESTICUS EMBRYOS

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The objective of this research was to determine the effects of aluminum concentrations on Gallus domesticus embryos. It was known that the brain tissue of victims of Alzheimer's Disease contains numerous deposits of aluminum. This research project was selected to investigate the relationship of strength of aluminum concentrations to the development of nerve cells. The hypothesis was that the aluminum concentrations would significantly affect the cellular structure and cellular functions of the embryo nerve cells.

Three dozen fertilized eggs were incubated for a period of nine days. Powdered aluminum was suspended in normal saline to form the concentrations. On the third day of incubation, the eggs were injected with 1cc of an aluminum concentration and sealed with paraffin. The eggs were then returned to the incubator. Extra specimens were periodically checked for embryo development. On the ninth day of incubation, all the eggs were opened. All the embryos were living at the time they were sacrificed. Post-mortem autolysis was prevented by the immediate immersion of the brain tissue in Bouin's solution until the paraffin series was initiated. Paraffin blocks were made, and the tissue was sectioned at two and one half microns with a rotary microtome. The material was mounted, and slides were prepared using hematoxylin stains. Photomicrographs were taken of the slides.

Based upon the data collected, it was determined that the aforementioned aluminum condentrations did not significantly affect the cellular structure nor the cellular functions of the nerve tissue of developing Gallus domesticus embryos. Therefore, the hypothesis was false.

# ANALGESIC RESPONSE IN THE ALLOXAN DIABETIC RAT

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Diabetes Mellitus is thought to result in many complications in diabetics who do not maintain longterm euglycemic control. One such complication, painful diabetic neuropathy, causes intense lower extemity discomfort in older diabetics. Neuropathy may result from excess sorbitol and/or reduced myoinositol in the nerves. Hyperglycemia causes both of these conditions. I hypothesized that hyperglycemia in diabetic rats would create a low analgesic condition while hypoglycemia would create a high analgesic condition. In order to investigate these conditions five alloxan induced diabetic rats' responses where measured by placing their tails in 50° C water and measuring the time lapse before the tail flick response delay. These values were then compared to nondiabetic control rats' response times. As hypothesized, it was found that analgesic response was greater in hypoglycemic diabetic rats. This response corresponds to that of the control rats, i.e. the response to the thermal stimuli was in normal range when the diabetics were hypoglycemic. Hyperglycemia resulted in significantly lower analgesic responses. These results can be applied to the healthcare of the many diabetics suffering from diabetic neuropathy. Painful complications have been reported by diabetics to be more severe during hyperglycemia. These data confirm that hypoglycemic conditions yield higher analgesic responses. Using this research, a diabetic could be influenced to keep his blood glucose levels in a euglycemic range and therefore better control his discomfort.

#First Award - General Motors ISEF

*PROTECTION OF ACETYLCHOLINESTERASE AGAINST ORGANOPHOSPHATES BY HUMAN SERUM

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Organophosphate (OP) chemicals, including insecticides and chemical warfare agents, exert their primary toxic effect by inhibition of acetylcholinesterase (AChE). The primary target site in higher animals is the central nervous system, and chemicals absorbed by ingestion, inhalation or dermal exposure reach the nervous system via the blood. The purpose of this study was to determine the role of serum proteins as possible protective agents against OP's. OP's were exposed to serum, to three serum fractions, or to serum proteins for 15 minutes prior to addition of AChE source (bovine brain plasma membranes). Four OP's were selected on the basis of similar potency as AChE inhibitors but with differing physical properties; none were insecticides or warfare agents.

Results: Whole serum provided varying degrees of protection against all four OP's. In general, protection increased with decreasing polarity of the OP. Serum fractions provided greatest protection with the fraction precipitated by from 35% to 65% saturation with ammonium sulfate; virtually no protection was provided with the 65%-90% fraction.

Conclusions: (1) Serum decreases OP available to inhibit brain AChE. (2) Albumin is a major binding protein for OP's, especially those of low polarity. (3) Two OP's inhibited serum pseudocholinesterase, but significance of this reaction in the protection process has not been determined.

*Third Award - General Motors ISEF

CAFFEINE, CHOLESTEROL AND TRIGLYCERIDES

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This paper investigates the effect of caffeine, the most widely used psychoactive stimulant in the world, on serum cholesterol and triglyceride levels. Both increased cholesterol and triglyceride levels are associated with atherosclerosis, the major cause of death in the Unites States. The hypothesis expresses the belief that caffeine will cause an increase in both serum cholesterol and triglyceride levels in New Zealand White Rabbits.

The rabbits were divided into four groups for this study -- a control group, and groups given the equivalent of one, five, or ten cups of coffee. The rabbits were gavaged daily with a caffeine solution or distilled water. Each week .5 to 1.0 cc of blood was taken from the marginal ear vein of each rabbit. The serum cholesterol and triglyceride levels were then analyzed at McNeil Pharmaceutical using the Gilford SBA 300.

After all the data was collected, an analysis of variance using the .05 level of significance was performed. This showed the hypothesis to be incorrect. Increased caffeine consumption did not result in an increase in either serum cholesterol or triglyceride levels.

#THE EFFECTS OF WHOLE-BODY HYPERTHERMIA, CHEMOTHERAPY, AND COMBINED WHOLE-BODY HYPERTHERMIA AND CHEMOTHERAPY ON NORMAL ANIMAL TISSUE. Thomley, Jill E., Calvin M. Woodward High School, Toledo, Ohio 43608; 3411 Worley Pl. Toledo, Ohio 43608

This project was conducted under the direct supervision of Dr. Andrew J. Milligan, PhD, at the Medical College of Ohio at Toledo in conjunction with a series of related projects funded by a National Cancer Institute grant. The purpose of this study was to investigate the possibility of using hyperthermia to enhance the effects of the chemotherapeutic agent Adriamycin. RAts were used as the subjects in this study, a different set being employed in each phase.

Phase I of this study was conducted to establish a control base for hyperthermia treatment. The rats were anesthetized with sodium pentabarbitol for the duration of the hyperthermia treatment. The anesthetized subjects were placed in a lead lined plexiglas containerwhich was immersed in a heated water bath, and the temperature of the subjects was constantly monitored by a rectal thermocouple. Various time periods and two temperature ranges were used, and it was observed that as the time-temperature factor increased, there was a marked deterioration in certain tissues.

Phase II of this study was conducted to establish a control base for Adriamycin treatment. Various doses of Adriamycin were administered to the subjects, which were then observed to determine the effects, if any, resulting from the treatment. It was noted that as the dosage increased, tissue change was more pronounced.

Phase III was conducted employing a combination of the most advantageous treatments as determined by Phase I and Phase II. The highest dose of each treatment which produced no adverse effects alone was used. Hyperthermia treatment was given according to the methods employed in Phase I, except Adriamycin was administered immediately prior to treatment. The subjects again were anesthetized throughout treatment. As in Phase II, the subjects were monitored to observe tissue change. The observations show that the extent of tissue change was much greater when hyperthermia was used with Adriamycin.

In conclusion, the results of my study show that hyperthermia treatment does enhance the effects of Adriamycin.

#Third Award - General Motors ISEF

HEME IRON IN GROUND BEEF

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The 1980 edition of RDA recommends that in computing absorbable iron in food, that heme iron be calculated as being 40 percent of the total iron in animal tissue. Researchers are now showing heme iron to be greater than 40 percent. Hamburgers were purchased at three different times during the day, from three different commercial outlets. This sampling method would reflect different meat lots and different cooking techniques. The patties were brought to the laboratory and portions were weighed, dried, reweighed, and moisture content was measured. Total iron and heme iron content was then determined from each sample following the AOAC official final colormetric method. The percent of the heme iron content was 62-84 percent. The average of the samples was 71 percent. This agrees with the recent research showing that beef is a better source of iron than has been thought.

*OVA IDENTIFICATION OF PARASITIC HELMINTHS IN CANIS FAMILIARIS IN BROWNING, MONTANA, ON THE BLACKFEET INDIAN RESERVATION AND THEIR PROBABLE TRANSMISSION TO THE HUMAN POPULATION

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Canis familiaris feces samples were gathered at random in sections of Browning, MT, on the Blackfeet Indian reservation. A saturated sugar floatation was adopted to float the Helminth ova for later observation. Each feces sample was floated and observed twice for accuracy of identification.

The floats were observed and were found to contain eight Helminth species. Toxocara canis and Toxascaris leonina were the two predominant Helminths found. Therefore, the present study was directed toward these two species. The occurrence of these two Helminths were compared using the chi-square value and found to be significantly higher than the national average.

It was concluded that there was an abundance of Helminths that were identified which were transmittable to Homo sapiens. These Helminths weaken the immune system of humans as well as that of the canine population, which could lead to the canines harboring other transmittable parasites and diseases. By assuming that each feces sample was excreted by separate dogs, it can be concluded that there is a large population of infested dogs wandering throughout the community.Therefore, if the dogs excrete throughout the community and contaminate the environment, the possibility of human contamination is considerably increased, which creates a public health hazard. This makes it evident that it is necessary to decrease the percentage of Helminth carriers in the community for the general health of the human population.

*First Award - American Indian Science and Engineering Society
Fourth Award - General Motors ISEF

A STUDY OF CYTOMEGALOVIRUS AS A POSSIBLE ETIOLOGICAL FACTOR IN ARTERIOSCLEROSIS

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As the leading cause of death in the Western world, Arteriosclerosis has been the subject of much research for the past several decades. Very little, however, has been established as to the specific etiology of the disease.

In a project conducted by myself in 1985, 100 aortas from freshly slaughtered pigs were examined and found to show early stages of atheromatous plaque development. In light of the recent studies concerning herpes viruses and arteriosclerosis, an attempt was made to detect CMV in frozen sections of these lesions using immunofluorescence staining. Positive results were obtained, encouraging continuation along this line of research. 50 additional porcine aortas were examined for atheromatous plaques and frozen sections of such lesions were stained for CMV. Tissue culture techniques were also employed to isolate the virus by inoculation of susceptible cell cultures with extracts of the aortic lesions. The cell cultures were monitored for cytopathic effects and were also stained for CMV using immunofluorescence.

Positive staining was encountered in 19 of 25 frozen sections and in 58 of 120 cell cultures. Varying degrees of cytopathic effects were observed in 32% of the inoculated cell cultures as well. These results indicate evidence of a significant CMV presence in porcine arteriosclerosis.

LOCALIZATION OF BENZO (A) PYRENE IN THE HAMSTER LUNG USING AUTORADIOGRAPHY

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The interesting aspect that is important in defining the development of human lung cancer, is that while the entire lower respiratory tract is exposed to the carcinogen, the tumors induced are localized predominately in specific segments. The purpose of this project was to determine if localization of Benzo (A) pyrene (a known carcinogen) in specific regions or cells may be involved in the mechanism of the segmental localization of tumors, and if so, to define which regions or cells within those regions showed the highest exposure to that carcinogen. To achieve these goals, radioactively labeled BP was administered to hamsters and followed in the respiratory tract by autoradiographic techniques at various times after administration.

In hamsters given intratracheal instillations of BP/ferric oxide, the highest incidence of carcinomas are found in the extrapulmonary and intrapulmonary brochi. Lower incidences appear in the trachea and larynx and none in the bronchiolar and alveolar area (Saffiotti, et al., Cancer Reasearch 28, 104, 1968). In the present study, the greatest nuclear binding of the carcinogen was consistantly correlated with the epithelial segments where the hightest incidences of tumors are reported.

These findings are consistant with the conclusion that selective binding of BP by localized epithelial segments may play a role in the mechanism for the regional induction of tumors in the respiratory tract.

ANTICANCER ACTIVITY IN VIVO IN TWO NEW EXTRACTS OF ARGEMONE MEXICANA L.

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Bo. Mariana, Naguabo, P.R. 00718

The Argemone mexicana L. grows wild in Puerto Rico. Where is known as "Cardo santo". This plant were used by colombian indians for the treatment of cancer patients. This study was undertaken to evaluate anticancer in two new extracts of this plant. The study was performed In Vivo on Mus-musculus males of C.D.1 strain of aproximated age and weight. The following extracts were tested: extract #1 consisted of flowers in distilled water, extract #2 consisted of seeds in distilled water; the concentration of these extracts were 20%. The anticancer activity of the extracts were tested with Ehrlich Ascities tumor cells grown in Mus-musculus. The thirty mice were intraperitoneally inoculated with 10^5 Ehrlich Ascities tumor cells per mice. Forty-eight hours after inoculation mice were divided in three groups of ten mice each. Group #2 served as tumor control, group #3 had tumor and were treated with extract of flowers in distilled water, group #4 had tumor cells and were treated with extract of seeds in distilled water. Group #1 served as uninoculated control and groups #5, #6 as toxicity control for the different extracts. The treatment with the extracts started forty-eight hours after tumor implant and consisted of every week intraperitoneally inyections of 0.1 ml of indicate extracts. The extract of flowers in distilled water protected 80% of the mice. The extract of seeds in distilled water tested protected 90% of the animals. Histologicals studies demonstrated an effective and significative anticancer activity.

EQUAL: SOME BITTER FACTS WITH THE SWEET

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To determine the effect of EQUAL, a sugar substitute derived from aspartame, three sets of mice were given amounts of EQUAL in their H_2O based on the recommended daily allowance of EQUAL for mice (44mg daily). 1 packet of EQUAL was added to 100ml of H_2O to yield a .28mg/ml concentration. 1ml of that solution was added to 10ml of H_2O and diluted 2 more times in 10ml of H_2O to provide .028, .0028, and .00028mg/ml concentrations, which are far below the RDA. Mice were fed these dilutions daily along with 10g of grain daily. Weights and behavior changes were recorded weekly. A maze test was set up to test for memory impairment. The mice which received .028mg of EQUAL died of no determinable cause, but because there are not known toxic levels of EQUAL, poisoning can be ruled out. The remaining mice were sacrificed with ether and the organs were placed in formalin until paraffin blocks could be made. A microtome was used to cut thin sections for the slides. Pathological procedures done on the experimental mice revealed that only the liver was damaged by the slight metamorphosis of fat in the liver cells. Other organs were not effected. It was noted that the experimental mice experienced some abnormal behavior compared to the controls. The weight gains of all the mice remained fairly consistent. The maze tests suggest possible memory impairment. This being a quantitative study, results obtained from only a few mice can only suggest that EQUAL may be harmful at certain levels.

SOLAR PROTECTION: AN IN VITRO STUDY TESTING THE EFFECTS OF SUNSCREEN AGENTS IN PREVENTING ULTRAVIOLET RAY-INDUCED MUTATIONS

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Excessive solar exposure can promote skin cancer. In order to reduce this risk, commercially made sunscreen products are applied to the epidermis. The goal of this second year experimentation is to determine whether or not four commonly use sunscreen agents, PABA,Homosalate, Padimate O. & Oxybenzone, can prevent mutations of an in vitro mouse cell culture of the L5178Y cell line, induced by ultra-violet irradiation of the erythemal (UV-B) & germicidal (UV-C) wavelengths. In the preliminary experiments, the UV-B & UV-C doses were set at 1.5 min. & 6.6 sec.respectively. The chemical concentrations were determined non-toxic at .5 mg/mL & 1.25 mg/mL. Growth curve and fold growth cells were maintained for each of the eleven experiments, testing only one chemical concentration and UV exposure at a time. The fold growth cells were cloned in soft agar and incubated for twelve days, after certain cells were treated with triflurothymidine. The mutation frequency could then be computed from the colony counts. By comparing the percentage of mutation frequency decrease, and fold growth increase of the different sunscreen chemical agents, the most effective could be deduced. Through the results obtained in this study, PABA demonstrated to be the most effective UVR-protector.

#Third Award - General Motors ISEF

THE EFFECTIVENESS AND EFFICIENCY OF THE AUDIOGENIC SEIZURE MODEL IN EPILEPSY RESEARCH,

By Adam B. Steen, Hayfield Secondary, Alexandria VA 22310 — 7720 Hayfield Road, Alexandria, VA 22310

Many types of seizure models are used when researching epilepsy; all of which have both attractive and unattractive characteristics. Seizure models must be effective and efficient in order for the researcher to produce significant results. The Audiogenic Seizure (AS) model is no exception to this rule. My project deals with determining the effectiveness and efficiency of the AS model, exclusively. Determining these characteristics involves long-term testing and knowledge of the models' epileptic behavior. Twenty Sprauge-Dawly Audiogenic rats (genetic seizure subjects) comprise my test group. Each rat is tested for consistent Audiogenic Response Seizure (ARS) levels up to seven times, or until a consistency in ARS levels is present. Testing of the subjects' seizure levels is done by introducing a 120 Db-5Khz bell into the rat's environment. Observation is the key to ranking the model — a trained eye is mandatory. After a period of three weeks and one day of testing (which is relatively time consuming in comparison to other models), I found more inconsistent subjects than consistent ones. Hence, further testing of questionable subjects was necessary. After the additional testing for consistencies was complete (total test time of four weeks, 3 days), my main conclusions could be satisfied. The AS model in my sutdy is INEFFICIENT for the researcher (i.e., 42.85% of the population was consistent and 57.14% of the population was inconsistent). The time-consuming task also attributed to this finding. On the other hand, the model was found EFFECTIVE, seeing as 100% of the consistent subjects found their way to epilepsy research.

#PHOTOSENSITIZED DAMAGE TO CULTURED BOVINE CORNEAL ENDOTHELIUM BY FLUORESCEIN

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The purpose of this project was to determine if sodium fluorescein is a photosensitizer. Experiments were conducted to study the effect of fluorescein on the damaging effects of light. Bovine endothelial cells in culture were exposed for varying durations and at different intensities to blue light (450-490 nm) in the presence of different concentrations of fluorescein (0.0%, 0.0001%, and 0.001%). A quantitative scale was developed to measure the degree of damage produced by light. Increasing the exposure energy produced an orderly increase in damage. At a concentration of 0.0001% the degree of damage was not different than that observed without fluorescein (0.0%) while the damaging effect of light was significantly enhanced 3 times with 0.001% fluorescein over control conditions. It was concluded that fluorescein is a photosensitizer but only at concentrations above that which occur in the aqueous humor of patients who undergo fluorescein angiography.

#Second Award - Tissue Culture Association
Fourth Award - General Motors ISEF
Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

MICROBIOLOGY

DETERMINATION OF OPTIMUM MEDIA, PH, AND TEMPERATURE FOR THE BIOSYNTHESIS OF CELLULOSE FROM ACETOBACTER XYLINUM AND COLLAGEN FROM ALCALIGENES EUTROPHUS

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A novel segment of research today is the biopolymer industry. Polymers, compounds with a repeating monomer unit, are usually synthesized in a laboratory setting. Recently, however, they have been produced biologically by culturing a bacterium which extrudes the polymer. Two such bacterium are Acetobacter xylinum and Alcaligenes eutrophus which biosynthesize cellulose and collagen, respectively. In order to determine the optimum conditions for growth, several environmental conditions were set up and while one varied, the rest remained constant. The conditions were media, pH, and temperature. For each bacterium 27 flasks were cultured with a total of 54. After a three week growth period, the samples were filtered and the dry weights determined. From this data, optimum growth and high yield conditions could be established. To identify the bacteria substances as biopolymers, an Amino Acid Analyzer was used for the collagen, and Infrared Spectroscopy was employed to identify the cellulose. To determine whether the interaction between the environmental variables had any significant effect on high polymer yields, the two-way Analysis of Variance was used as a statistical test.

ASCERTAINING THE MUTAGENICITY OF SPECIFIC CHEMICALS USING HISTIDINE PROTOTROPHIC SALMONELLA TYPHIMURIUM

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This project ascertains if specific chemicals are mutagenic. The test chemicals were aniline, dioxane, ethyl alcohol, ethylene glycol, formaldehyde, hexane, methanol, and pyridine.

The tester strain of bacteria used was *Salmonella typhimurium* because specific genes are easily frameshifted in response to a chemical exposure. The mutatant *S. typhimurium* requires histidine to be provided in a multi-layered agar. Wild *Salmonella* can manufacture its own histidine and, therefore, can grow in agar without histidine. It is possible to obtain visual proof that a reverse mutation has occurred if histidine-requiring *S. typhimurium* is exposed to a chemical in one facit of agar not containing the required histidine. This penetration and growth indicates that a chemically-induced mutation has occurred. In all tests, positive controls of benzene and negative controls of sterile distilled water were implemented. The presence of histidine was verified by electrophoreses and chromatography.

The conclusion is that evidence of mutated bacteria appeared in the bottom layer of agar of all the test chemicals. Therefore, it can be concluded that all of these test chemicals are mutagenic. These results confirm that mutations have occurred refuting the null hypothesis.

A THREE YEAR STUDY OF BACTERIAL CONJUGATION AND GENETIC RECOMBINATION: PHASES IV & V THE MUTAGENIC EFFECT OF SMOKELESS TOBACCO

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Bacterial conjugation is a process of cell to cell contact involving the one way transfer of the genome and the episomes from a donor to a recipient strain. F^+ cells carry a fertility factor episome. The F factor can become a part of the host bacterium's chromosome, making it a high frequency recombinant (Hfr). The purpose of Phase IV and V was to study the mutagenic effect of smokeless tobacco on the genome of the Hfr strain and on the genome transfer to the F^-.

The test organism, E. coli, carries the F episome for conjugation. In Phase IV experimentation, the Hfr (CSH 61) was mutated with an extract of smokeless tobacco, diluted, and plated on selective medium to determine the mutagenic effect on the genome. In Phase V, conjugation of the mutated Hfr and F^- parent (CSH 50) was interrupted at 5-minute intervals and plated on selective mediums to determine the effect of the mutation on genome transfer and to locate the gene site at which it occurred.

Phase IV results suggest that there was a change in the DNA structure of the Hfr strain, due to the mutagenic effect of smokeless tobacco. This change resulted in the B_1^- Hfr becoming B_1^-, lac^-. Phase V, results show that the mutant remained an Hfr, since its gene markers transferred in the same order as the parent. These results further suggest that the mutation did occur at the lactose gene site, which is the 10 to 15 minute time interval during conjugation. Furthermore, one would conclude that a new technique has been developed supplementing the Ames test for determining mutagenicity and potential carcinogenicity.

#First Award - American Medical Association
First Award - General Motors ISEF

ANTIBIOTIC EFFECT OF STREPTOMYCIN INCREASED BY PLANT GROWTH REGULATOR

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It was reported several years ago that indole-acetic acid (IAA), a plant growth regulator, increased the protective effects of streptomycin (SM) against fireblight in apple trees. More trees survived when sprayed with a mixture of IAA and SM than when treated with SM alone. The purpose of this experiment was to determine if IAA increased the antibiotic effect of SM by a direct effect on bacteria rather than by increasing the resistance of the host. Various concentrations of IAA and SM were added separately to cultures of Bacillus subtilis during the exponential growth phase. SM in a concentration of 10 micrograms/ml was found to have a slight inhibitory effect on the growth of Bacillus subtilis. IAA in a concentration of 100 micrograms/ml did not affect the growth of the organism. However, when the chemicals were added together in these two concentrations, growth was further inhibited by 25%. The results show that IAA does increase the antibiotic effect of SM by a direct action. It is possible that IAA may increase the permeability of the cell wall or cell membrane of the bacteria to allow more antibiotic to enter the cell.

#Third Award - General Motors ISEF
Fourth Award - American Phytopathological Society

THE EFFECT OF NATURAL SELECTION ON CHLORINE TOLERANCE IN MICROORGANISMS

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The purpose of this project is to see if natural selection occurs in certain microorganisms, (E.coli, serratia, air, and rain water bacteria), when using standard minimum and maximum chlorine solutions used in potable water.

I performed fifteen tests using .2 and 2 ppm chlorinated broth to compare bacterial growth patterns. Test 1 consisted of unchlorinated broth only as a control. Tests 2 through 5 had the various bacteria placed in unchlorinated broth as controls also. Tests 6 through 9 had the various bacteria placed in .2 ppm chlorinated broth. Tests 10 through 13 had the different bacteria in 2 ppm chlorinated broth. Tests 14 & 15 were controls which had the minimum and maximum amounts of chlorine used for potable water in the broth. This was done to prove that the bacteria, not the chlorine, was changing the density of the broth. Observations of each test were taken every 4 hours. I did the experiment for 3 successive generations with .2 ppm chlorine and 4 successive generations with the 2 ppm chlorine to see if and how long it took for the bacteria to become resistant.

I concluded that: 1) Natural selection does occur when bacteria are treated with .2 and 2 ppm chlorine. 2) Bacteria populations become resistant to the minimum dose of chlorine (.2 ppm) in a 2-day period and the maximum dose of chlorine (2 ppm) in a 3-day period. 3) The resistance to chlorine was retained in subsequent generations of the tested bacteria.

#THE STUDY OF THE RELATIONSHIP BETWEEN RHIZOCTONIA SOLANI AND POD DAMAGE IN ARACHIS HYPOGAEA

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The purpose of this investigation was to establish if a relationship exists between Rhizoctonia solani and pod damage in Arachis hypogaea, and, if so, what that relationship is.

Four sites were chosen based on the past years percentage of diseased peanuts. Soil samples and volunteer plants were collected. Populations of Rhizoctonia solani should be greatest in sites one and two; site four should have fewer numbers and site three should have the least population. The plants will be used to further substantiate findings, and also illustrate that the fungus can live on and benefit from organic matter.

The soil samples were cultured on Flowers' media for approximately four days, after which the numbers of colony forming units of Rhizoctonia and Ceratobasidium (long thought to be Rhizoctonia) were identified and recorded. The plants were arranged in a randomized split-plot experimental design. Wheat straw was added to some, and all were allowed to grow for approximately 2 months. The pods were then harvested, and both pods and kernels were cultured on PDA to identify the pathogenic organism(s).

Data supports the hypothesis. In all soil samples, Ceratobasidium outnumbered Rhizoctonia suggesting that this relatively new species of fungi maybe another cause of local pod damage in Arachis hypogaea.

#Fourth Award - General Motors ISEF

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*ISOLATION OF BACTERIA THAT MODIFY ANTIBIOTICS

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The purpose of this research is to isolate bacteria capable of converting known antibiotics into forms that are toxic to antibiotic-resistant bacteria. Hundreds of soil bacteria were screened at various streptomycin concentrations. Thirteen strains exhibited the ability to produce halos of clear areas within a background of the streptomycin-resistant indicator strain. In the next screening phase, only one of the thirteen strains produced an antibiotic-dependent growth inhibition in the indicator strain. The convertase culture was further studied by running growth curves of the following cultures with streptomycin-resistant E. coli as the indicator strain. A) Streptomycin-resistant E. coli. B) Streptomycin-resistant E. coli plus 50 micrograms per milliliter streptomycin. C) Streptomycin-resistant E. coli plus filtrate from convertase culture grown in the absence of streptomycin. D) Streptomycin-resistant E. coli plus filtrate from convertase culture grown in the absence of streptomycin; but was spiked with enough streptomycin to bring the concentration to 50 micrograms per milliliter. E) Streptomycin-resistant E. coli plus filtrate from convertase culture grown in the presence of 50 micrograms per milliliter streptomycin. All four control cultures(A,B,C,D)produced strikingly similar growth patterns. The experimental runs, containing streptomycin-resistant E. coli grown in the presence of 50 micrograms per milliliter converted streptomycin, in all cases exhibited dramatic suppression of growth. The emergence of antibiotic-resistant pathogens presents a significant and continuing challenge to the health care industry. These findings suggest a new approach to antibiotic modification. Isolation of antibiotic converting bacteria may result in development of antibiotics that inhibit known strains of clinically important antibiotic-resistant bacteria.

*Fourth Award - General Motors ISEF

THE AMERICAN CHESTNUT BLIGHT

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The purpose of this investigation is to observe the possible effects of the hypovirulent strain of the fungus Endothia parasitica on the growth of the virulent strain of the chestnut blight.

The hypothesis of this experiment is that if the hypovirulent strain of the chestnut blight is an effective control of the virulent strain of Endothia parasitica, then a decrease in the growth of the virulent (V) strain of the fungus will be observed when cultured with the hypovirulent (HV) strain as compared with the growth of the V fungus in isolation.

In order to obtain results, fifteen petri dishes were innoculated with the two types of fungi for this experiment. Five plates contained samples of the virulent fungus alone, five contained samples of the hypovirulent fungus alone, and five contained samples of both the virulent and hypovirulent fungus cultured together. Every other day the average surface area of each strain of fungus in each dish was measured in terms of milimeters squared, and pictures were taken of samples of the dishes. The experiment was then repeated in order to verify the results.

From the results found in the experiment it can be concluded that both types of fungi grow at very similar rates when cultured alone. Since the HV fungus gradually encompassed a much larger area than the V strain of the blight when the two were grown together, it can also be concluded that the hypovirulent strain of the fungus is an effective control of the chestnut blight.

EFFECT OF GAMMA RADIATION ON DNA WHEN IN VITRO

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The purpose of my research was to show if and how ionizing radiations effect the D.N.A. of various microorganisms when in vitro. The project was undertaken in three phases. First, preliminary research was completed, and sufficiant data collected to establish a feasible procedure. This research was imbarked upon in July of 1985.

All of the data was obtained from the University of Utah medical library and personal experience. The dosages for the radiation were determined through an extensive series of experiments.

The second phase was the actual experimental research. This was started on December 3, 1985. The bacteria selected for this phase were as follows; Serratia Marcescens, Sarcina Lutea, and Bacillus Subtilis. These bacteria were selected for their varying tolerance to radiation. Each of nine subcultures was irradiated at varying RAD levels. The cultures were tested to show variations in tolerance to enviromental factors. The cultures were then reincubated and retested. All of the mutations had been inherited, showing that the mutations had been in the D.N.A.

The third stage was compiling and interpreting the data gathered in the above process. The data was processed and conclusions were drawn.

KICK MICROORGANISMS IN THE MOUTH

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The object of this experiment was to test the effects of mouthwashes in destroying or retarding the growth of microorganisms since T. V. commercials are always expounding on how good their products are.

The procedure included sterilizing and preparing 3 sets of culture plates with sample microorganisms from selected areas. The samples were incubated until various colonies were visible for 3 days. Each day the microorganismal growth was recorded by tracing on a transparency using a different color. On the fourth day, mouthwash was added to each set of culture plates and the growth patterns were continually recorded.

With limited testing, the hypothesis was proven wrong because the different brands of mouthwash did not retard or destroy the microorganismal growth.

After extensive testing and if the results remain the same, that different brands of mouthwash do not significantly retard or destroy the growth of the microorganisms, then the mouthwash habit could change.

If the Food/Drug Administration investigates and proves the results, then the public's use of mouthwash may decline.

HEALTH HAZARD: A MICROBIOLOGICAL STUDY OF THE DEGREE OF CONTAMINATION OF THE POPULAR FOOD ITEM KNOWN IN PUERTO RICO AS "CARNE AL PINCHO"

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In the last few years in Puerto Rico the sale of pork meat "pincho" has become very popular in ambulatory public stands.

I carried out a research study of the microbes found in such a meat in the Mayaguez area. The study included five public stands. Each stand has been sampled weekly during a month and a half. I made specific cultures for fungus and bacteria of the family of Enterobacteriaceae.

The media used were Potato Dextrose Agar (P.D.A.) with Cloramphenicol Tetrasicline and Rose Bengal. The plates were incubated for 24 hours at 35°C and after that I worked on the subculturing in Nutrient Agar of each one of the colonies found. Biochemical tests were carried out using the fresh cultures. Furthermore, I set aside all species of *Candida* found in each of the samples for future determination of species.

The organisms encountered in the cooked meat, according to *Bergey's Manual of Determinative Bacteriology* correspond to the following genre: *Salmonella*, *Shigella*, *Escherichia*, *Proteus*, *Enterobacter* and *Citrobacter*.

The bacterias *Typical salmonella*, Salmonella *arizonae*, *Escherichia coli* and *Shigella sonnei* are pathogenic. They cause gastroenteritis and infection of the intestine in human beings. Raw meat yielded the same bacterias but in double amounts. The sauce was negative for the presence of bacteria.

STUDY OF THE INHIBITION EFFECT OF ALGAES, PLANTS AND CONDIMENTS ON CANDIDA ALBICANS IN DIFFERENT TEMPERATURE.

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Many plants (leaves), algaes, condiments and sugar have been used to cure conditions in living organisms. That's why I considered them to study, their effects in the pathogenic fungu *Candida albicans*. To try to control, the growth of the fungus. I applied; 19ml of infusion (50gr of the especimen in 100ml of H20) and different concentration of sugar, to the cultives inoculated on Nickerson and Maicocell agar. This investigation was realized at 5 grades F. and normal temperatures. They were observed for 10 days. In this lapse of time I observed that some plants, algaes, condiments and low concentration of sugar have inhibition effect in the fungu. I conclude that the specimen used in the investigation serve as an inhibator substance on the pathogenic fungus *Candida albicans*.

INTER AND INTRA SUSCEPTIBILITY TO *AGROBACTERIUM TUMEFACIENS* INFECTION

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Agrobacterium tumefaciens, a gram negative soil bacterium, causes tumors to form in dicotyledon plants. The tumor induction involves the transfer of a portion of tumor inducing plasmid DNA from the bacterium to the plant cell. This research investigates the inter and intra family susceptibility to the bacterium infection. Also, the growth rate of tumors at different bacterial growth stages and tissue sensitivity were studied. The bacterium was cultured at different concentrations in YEG broth. Bacterial cell counts were made using a hemacytometer. A concentration of $2.8x10^6$ bacteria per milliliter was obtained.

Two families,Solanaceae and Cruciferae, were used in the research. Twelve plants of each species were used. Two plants were controls; the remainder were divided into two groups of five to be infected with the bacterium. The experimental groups of plants were inoculated with solutions having different bacterial growth stages. The concentration of bacteria was constant in all inoculations. When inoculating the plants, each site was wounded and 4 microliters of solution containing $1.12x10^4$ bacteria were applied. Upper and lower leaves, and stems were inoculated. All plants were fertilized and kept in a controlled environment.

When comparing the inter family susceptibility to the bacteria, it is evident that the Solanaceae family consisting of petunias and peppers was more susceptible than was the Cruciferae family containing the cabbage and cauliflower. The Solanaceae family had a greater abundance of tumor growth on the stems; the Cruciferae had slight tumor growth on the upper and lower leaves only. In both families, there was greater tumor growth in the second bacterial growth stage than the first. Sterile techniques were employed throughout the experiment.

THE DETECTION OF INTERFERON GAMMA PRODUCING CELLS

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Interferon (IFN) gamma is produced in response to antigens and can mediate the inflammatory response. However, IFN gamma producing cells have not been visualized in cultures of human peripheral blood lymphocytes.

The purpose of the project is to develop a method for detecting IFN gamma producing cells.

Human peripheral blood lymphocytes were stimulated with staphylococcal enterotoxin A (SEA) and pokeweed mitogen (PWM) and maximal levels of IFN gamma were produced within three days past stimulation. Lymphocytes from stimulated and control cultures were harvested and air dried onto glass slides. Antisera made against the amino-terminal of human IFN gamma and against partially purified human IFN gamma were used to stain specifically for IFN gamma producing cells.

Findings indicate that these reagents can be used to specifically detect IFN gamma in cells in stimulated cultures. They also suggest that there are lymphocytes circulating in our body that make IFN gamma after stimulation with antigen (SEA). The discovery of circulating IFN gamma producing cells may be important in detecting people with certain diseases, especially if the number of cells are increased or decreased. Thus, further work is needed to establish the importance of this phenomenon.

CONSTRUCTION OF AN EXPRESSION VECTOR FOR THE STUDY OF THE EFFECT OF ENHANCERS ON THE BETA-GLOBIN PROMOTER

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It is hoped that in the future genetic diseases will be cured by the use of gene therapy. In order for this to become feasible, scientists must first understand how gene expression is regulated. The disease Beta-thalassemia is a prime target for treatment by gene therapy, but first the factors that control the expression of the Beta-globin gene at the molecular level must be studied. This can be done by working with plasmids, small covalently closed circles of DNA. Plasmids can be manipulated without much difficulty; techniques have been developed to produce plasmids with desired characteristics. These plasmids, if then placed in living cells, will replicate and express the genes they contain.

PCAT34 is a plasmid containing the promoter, or controlling region, for the mouse Beta-major-globin gene, followed by the CAT gene, which, when expressed, produces an enzyme that can easily be tested for. When an enhancer, which should increase gene expression, was spliced into pCAT34, the increase was not as great as expected. It was hypothesized that a DNA segment upstream of the Beta-globin promoter was a repressor inhibiting expression of the CAT gene.

An experiment was performed to remove the hypothesized repressor from pCAT34, thus creating an expression vector for the study of the effect of enhancers on the Beta-globin promoter. Some of the techniques used to accomplish this were restriction digestion, ligation, transformation, rapid plasmid isolation, purified plasmid isolation, and restriction mapping. Electrophoresis on agarose and polyacrylamide gels was used for testing altered plasmids. It was concluded that the expression vector was constructed as desired.

HISTOLOGIC BEHAVIOR OF VARIOUS EPITHELIAL TISSUES GRAFTED INTO SUBCUTANEOUS CHAMBERS

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The experiments conducted were aimed at seeing whether or not epithelia other than skin and oral mucosa could survive in graft chambers. Previous successes with the aforementioned tissues suggest that this is quite possible. BalbC females aged two months were used as donors and recipients of tissue. Tissues used were vagina, prestomach, small intestine, bladder, and skin. Tissues were cleansed with a chloramphenicol wash. The glass disk-silicone chamber technique was used in the transplantation of the tissues. After the initially implanted glass disk was removed, a small silicone chamber was used to protect the graft site; the skin was autoclipped to provide greater protection. After 3 days to 3 weeks, the chamber contents were removed. and paraffin processed. Slides were cut and stained with hematoxylin and eosin. Histologic observation revealed some successful transplants; others were necrotic. Results were limited somewhat by technical failure, but enough data was obtained to form conclusions. In the first experiment, vagina was very successful. In the second experiment, only urothelium and prestomach showed positive results. In the third experiment, introduction of growth factors and estradiol had little or no observable effect on short term transplantation. Results show that stratified squamous epithelia worked well; whereas, a suitable model for simple columnar and transitional epithelia needs more research. The positive results indicate that the chamber system could be used in studies of short term carcinogenesis in stratified squamous epithelia.

ANTIMICROBIAL AGENTS IN PSEUDOMONAS INFECTIONS: HOSPITAL ACQUIRED AND CYSTIC FIBROSIS PATIENTS

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PROBLEM: Metabolic, hematologic, and malignant diseases predispose patients to *P. aeruginosa* infections. The organism may produce disease when introduced into sterile tissues, but is rarely able to start an infection unless there is local or general impairment of defense mechanisms. In cystic fibrosis, colonization of the bronchi with mucoid strains of *P. aeruginosa* occurs regularly. This study was undertaken to evaluate the effects of some of the aminoglycosides on *P. aeruginosa* isolated from patients with hospital derived infections and from cystic fibrosis patients.

METHOD: Two standard ATCC strains of *P. aeruginosa* and one strain each from a cystic fibrosis patient and non-cystic fibrosis patient were maintained on trypticase soy agar slants at 37°C. Optical density readings of liquid cultures were used to form growth curves and determine the periods of logarithmic growth of the bacteria. Adenosine triphosphate assays were carried out by the bioluminescent technique using luciferase-luciferin system. Also the measurements of radioactive thymidine uptake were undertaken to determine the total mass of viable cells in the cultures. The eight drugs tested were amikacin, gentamycin, kanamycin, penicillin, rifampicin, streptomycin, ticarcillin and tobramycin. After appropriate periods of incubation, optical densities of the cultures were measured and also the bacterial ATP and thymidine incorporation.

SUMMARY: Only three of the eight drugs were effective. Tobramycin caused a 95% inhibition with 10 μg/ml, while amikacin at 20 μg/ml caused 88% inhibition and gentamycin, 91% inhibition at 50 μg/ml. The study is in progress.

RECOMBINATION

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In this project, the pattern of genes on a chromosome was analyzed. The fruit fly, *Drosophila melanogaster*, was used. A wild type and a mutant with the alleles - yellow body, crossveinless wings, vermilion eyes, and forked bristles, were crossed to produce heterozygous F1 progeny. These progeny were crossed back with pure stock of each type to cause crossing over and recombination.

The F2 female progeny from the wild type cross had to be ignored because they did not show recombined traits.

The percent of recombination was found by dividing the number of flies with a certain trait by the total number of flies counted.

It was determined by the data that the pattern of genes on a chromosome does follow a certain order. It was yellow body, crossveinless wings, vermilion eyes, and forked bristles, respectively. The percent of recombination was transformed into gene units and placed on a model of a chromosome section for easier interpretation.

# INHIBITION OF THE IgE MEDIATED IMMEDIATE HYPERSENSITIVITY ALLERGIC REACTION WITH MONOCLONAL ANTI-IgE RECEPTOR ANTIBODIES AND FAB FRAGMENTS: PHASE II

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This project determined if the IgE receptor sites of rat basophilic cells could be blocked with monoclonal antibodies (mAb) and their Fab fragments, thereby inhibiting IgE from binding to these sites. If IgE binding was inhibited, it was hypothesized that IgE mediated secretion of histamine from these cells would then be greatly decreased.

Four impure monoclonal IgG antibody samples thought to be anti-rat IgE receptor were obtained from mouse ascites. Each mAb was purified by 50% ammonium sulfate cut and ion exchange chromatography. Once purified, it was determined by radio-immuno assay that each mAb IgG set was indeed anti-IgE receptor, and would inhibit 99% to 100% of IgE from binding at concentrations greater than 10 micrograms per ml.

Each mAb caused some direct release of histamine (<30%). The basophil IgE receptors were blocked with increasing concentrations of the mAb´s. The cells were then stimulated to release histamine through crosslinkage of albumin-specific IgE and the antigen albumin. Controls not blocked with mAb released 45% of their total cellular histamine content while cells with IgE receptors blocked with high concentration of mAb released only 0-3% of their histamine content.

One mAb set was fractioned into Fab fragments by papaine digestion. These fragments inhibited IgE binding 100% at only .4 ug and resulted in no direct histamine release. IgE-mediated histamine release from basophils blocked with the Fab was inhibited 100% at .4ug of Fab.

Final experimentation involved in-vivo inhibition of passive cutaneous anaphylaxis in rats with the Fab molecules injected intradermally and intravenously. The administration of anti-IgE receptor mAb or Fab fragments may provide a means of inhibiting the immediate hypersensitivity allergic reactions in man.

#London International Youth Science Fortnight - United States Navy/ Office of Naval Research

Third Award - General Motors ISEF

TRANSFORMATION BARRIERS

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When an organismundergoes a mutation, part of its genetic code is altered. Both Acinetobacter type six (AC-6) and Acinetobacter type twenty-three (AC-23) are mutated versions of the Acinetobacter wild type (AC-5). While AC-5 can grow on minimal agar, AC-6 needs the amino acid tryptophan to live, and AC-23 needs both tryptophan and another amino acid, methionine. If the DNA is extracted from the AC-5, however, and is placed on either the AC-6 or the AC-23 bacteria, the mutant strain will accept the new DNA and actually become non-dependent on the amino acids. This is known as transformation. But what if another substance comes into play with this seemingly simple experiment? An organic compound, such as the common household food colors we use every day, can actually affect the transformation process. My experiment involoved different concentrations of the four basic colors; yellow, blue, green and red. Each was tested on both AC-6 and AC-23 transformations. The dyes themselves were in concentrations of one to ten, one to one hundred, one to one thousand, and one to ten thousand. The results were different for each dye and each concentration. Some resulted in significant growth inhibitions, others only affected size or number of colonies, but none completely prevented the transformation from taking place.

# MOLECULAR MECHANISM OF THE TOXICITY OF TDM FOR CELLS IN TISSUE CULTURE.

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The mechanism by which tuberculosis bacteria kill cells which ingest them has never been satisfactorily explained. They do not produce toxins like most pathogenic bacteria. In 1984, Myrvik *et. al* demonstrated that virulent tuberculosis organisms escape from phagosomes of macrophages following adhesion of phagosomal membranes to the organisms.

Trehalose 6,6'dimycolate (TDM) is an insoluble glycolipid found on the surface of virulent tuberculosis organisms. TDM is a most unusual substance in that its toxicity depends upon the configuration which it assumes at the surface. It is highly toxic for mice if injected as a monolayer on the surface of beads, but is practically devoid of toxicity if injected as cylindrical micelles. The toxic monolayer of TDM has a crystalline surface which resembles that of quartz.

I tested the hypothesis that the monolayer of TDM on beads can kill macrophages by disrupting phagosomal membranes by an adhesive mechanism similar to that of quartz. Transmission electron microscope studies of TDM coated beads in mouse peritoneal macrophages in tissue culture showed that the hypothesis has merit. TDM caused tight continuous adhesion of phagosomal membranes to the beads. This was followed by the appearance of tiny defects in the membranes which enlarged over a period of hours producing membrane disintegration, digestion of cytoplasmic elements and death of the cells. Phagosomal membranes adhered only in isolated patches to the surface of uncoated beads. Such beads remained in intact phagosomes and the cells showed little evidence of damage. This is the first demonstration that a bacterial product can exert toxic effects through a physicochemical adhesive mechanism. Since virulent tuberculosis organisms are coated with TDM, these observations suggest that the mechanism is important in tuberculosis infections.

#First Award - Eastman Kodak Company
First Award - United States Air Force
First Award - United States Navy/Office of Naval Research
Third Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

LYSOZYME AND ITS EFFECTS ON THE BACTERIAL COLONIZATION OF THE ORAL CAVITY,

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Except in rare instances *E.coli*, a common inhabitant of the intestinal tract, is not isolated from the oral cavity. *E.coli* has been shown to adhere to buccal cells in vitro., indicating that these cells of the mouth could be colonized if it were not for other factors. It was thought that lysozyme, a humoral protein found in saliva, may act as an inhibitor to bacterial colonization (8.11). This project explores the role of lysozyme in the bacterial colonization of the oral cavity.

The project was designed to test if lysozyme prevented the adhesion of piliated *E.coli* to oral tissue. Under conditions of normal saliva, A 0.1% solution of lysozyme was combined with a suspension of *E.coli* and buccal cells. This same test was also repeated at various concentrations of ionic strength levels. The level of bacterial binding was determined through light microscopy.

The results showed that the adherence of *E.coli* to buccal cells is controlled by substances in saliva, however, lysozyme alone did not inhibit adhesion but in fact promoted adhesion. The study also showed that ionic environment isa very imporant variable in the activity which takes place in the oral cavity. Statistical analysis of the results has shown the validity of the experiments. The results of this project should prove very helpful in the study of host oral immunity.

#ISOLATION AND FURTHER CHARACTERIZATION OF THE C TYPE MURINE LEUKEMIA VIRUS

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The C type murine leukemia virus (MuLV) has been suggested as a possible mechanism which may, through intra-genome incorporation and consequent transformation of plasma membrane structural proteins of the infected cell, induce auto-immune phenomena. This study attempted to determine whether transmission of MuLV occurs in a naturally auto-immune mouse strain via one or both of the sex cells.

Detection of MuLV was anticipated in lienocytes and hepatocytes in accordance with results of Lerner et al. (1976). Sperm and ova of NZB (afflicted) and ICR (normal) mice were tested for MuLV presence. Tissue sections of male testes and epididymides, female ovaries and uteri, and 18 day old embryos of various matings were examined using fluorescence methods.

Lienocytes and hepatocytes displayed positive staining for MuLV; however, kidney cells and spermatozoa exhibited no distinct staining. Tissue sections displayed intense staining of stereocilia and lining of the epididymal lumen, as well as light staining among spermatozoa. Interestingly, sections of testis taken simultaneously withepididymis displayed no staining whatsoever, indicating that the MuLV may be acquired as the sperm are propagated through the ductus epididymis.

These results provide evidence for the role of the sperm cell in natural vertical (progeny-linked) transfer of MuLV to a non-sensitized embryo. Tests upon reproductive tissues and ova in NZB females and embryonic tissue sections further support this possibility and indicate that the NZB female is not directly involved in vertical transmission of MuLV to progeny.

#First Award - American Society for Microbiology
First Award - Eastman Kodak Company
First Award - United States Army
Second Award - United States Air Force
Third Award - General Motors ISEF
Alternate to LIYSF Trip - United States Army

#AN INVESTIGATION INTO PLASMID-MEDIATED ANTIBIOTIC RESISTANCE IN ENTERIC BACTERIA ISOLATED FROM TURKEYS

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Antibiotics have been added to animal feeds ever since the 1950's when it was discovered that chlortetracycline speeds growth. Currently, there is a fear that this liberal use of subtherapeutic levels of clinically useful antibiotics is a threat to human health. In this investigation, Salmonella livingstone and Escherichia coli of turkey origin were studied. Their level of antibiotic resistance was determined, and plasmid DNA was isolated from them by gel electrophoresis. Conjugation studies were conducted with human E. coli and S. typhimurium. Antibiotic resistance was transferred from the turkey isolates, indicating the presence of mobile R-factors. Interrupted mating was used to roughly estimate the sequence of R-determinants on the plasmids. It was concluded that antibiotic resistance is high in the enteric bacteria of turkeys fed antibiotics, that this resistance can be plasmid-mediated and can be transferred in vitro to human enteric bacteria.

#First Award - American Veterinary Medical Association
Fourth Award - General Motors ISEF
Alternate to Scholarship - Ohio State University
Honorable Mention - American Society for Microbiology

#THE EFFECT OF COLONY STIMULATING FACTOR (CSF) ON DIFFERENTIATION OF MURINE MYELOID LEUKEMIC CELLS.

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Colony Stimulating Factor is a group of proteins produced by tissues throughout the body in response to infections. CSF controls the differentiation of haemopoietic stem cells which originate in bone marrow and mature into granulocytes and macrophages. I attempted to induce a murine myeloid leukemic cell line (M1) to differentiate by adding CSF. Leukemic cells multiply but lack the ability to mature. CSF (produced by mouse lungs in response to injection of bacteria) was added to cultures of M1 cells. Parallel controls without CSF were always included. After culturing for four days, cells were analyzed by five different parameters to determine differentiation: 1) morphological changes; 2) esterase production; 3)development of antibody receptors on cell membrane; 4) lysozyme production; and 5) phagocytosis. CSF-treated cells when stained showed obvious morphological changes and were photographed. A modified Koski stain procedure demonstrated the presence of esterase in treated cells. A rosette technique showed the development of antibody receptors on the CSF-treated cells. In this technique sheep cells coated with antibody attach to the Fc receptors forming distinctive flower-like clumps. Lysozyme extracted by freezing and thawing CSF-treated cells caused the lysis of the bacteria *Micrococcus lysodeikticus* suspended in agar. Phagocytosis was shown in CSF-treated cells by the ingestion of latex particles added during the final two days of culture. All tests with control cells were negative. I have shown that CSF does indeed stimulate undifferentiated (M1) cells to become mature and specialized by all the parameters above, while the untreated cells remain locked in their immature state. These observations pose the exciting possibility of the potential use of CSF in leukemia treatment.

#Fourth Award - General Motors ISEF

#EVALUATION OF INOCULATION METHODS AND EFFECTS OF AGROBACTERIUM RHIZOGENES AND AGROBACTERIUM TUMEFACIENS ON ROSA MULTIFLORA

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Agrobacterium rhizogenes and Agrobacterium tumefaciens are closely related, but each have markedly different effects on plants. Agrobacterium rhizogenes, once considered a pathogen, is responsible for hairy root disease in numerous species of higher plants. Agrobacterium tumefaciens is the etiological agent of crown gall disease. Rosa multiflora is the rootstock used for field grown roses. The induction of A. rhizogenes into R. multiflora is hypothesized to be beneficial in two ways. The increased root system should make the plant more drought tolerant, and A. Rhizogenes should compete with the A. tumefaciens, thus providing a potential biological control of crown gall disease. The first steps in this study were to determine if Rosa multiflora could be infected with these bacteria in a controlled situation and what inoculation methods produced the best results. Two methods were studied. The cuttings were soaked for 24 hours in a suspension, or the suspension was injected directly into the soil around the cutting. Both inoculation methods produced about a 25% infection of hairy root in surviving plants. The soak method had a 30% lower survival rate than soil inoculation. Galls were produced in 20% of the plants by soil inoculation with a strain of A. tumefaciens isolated from an infected rose plant. Infection was greatly reduced when a laboratory strain of A. tumefaciens was used. Results indicate a need for additional studies to improve infection rate prior to more advanced research.

#Third Award - American Phytopathological Society

# THE USAGE OF JALAPENO PEPPERS, GARLIC, AND SAGE AS A NATURAL PRESERVATIVE AND GERMICIDAL AGENT

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PURPOSE: To determine if home remedy items such as Jalapeno Peppers, Garlic, and Sage can work as a Natural Preservative on meat and if it can be used as a Germicidal Agent on cultures of molds and bacteria. PROCEDURE: I prepared 10 chem. preservatives at a 20-1 ratio of dist. water and chem.,prepared 13 home remedy preservatives. I applied 24 chem. and home remedy preservatives to 5 types of meat previously cut up and weighed to 10g a plate. Let them set at rm.temp. for 24 hrs. Swab the meat and smear bacteria on nutrient agar plate,complete this step for all 24. Place plates in incubator for 24 hrs. at 37c. Count bacteria colonies on each plate, record the colony count,record changes in meat and meat sol. To prove the most effective product I took the top 4 presv.& Sodium Nitrite and performed the same procedure as above, but instead of room temp. I put them in refrigeration. To prove the most effective product I took the top 2 of each catagory and performed the same procedure as above. Sensitivity testing on 5 molds,5 pure cultures of bacteria and 2 Staph. food poisonings,and 5 people(Staph. Epi.) I ranked the plates according to the width of inhibition zone, and took pictures each time. CONCLUSION: I found in the molds Benzoic Acid the #1 chemical preservative and Whole Garlic the #1 natural preservative, and Benzoic Acid the best overall. In the bacteria, Acetic Acid was #1 chemical preservative, and Whole Garlic the #1 Natural preservative,and Acetic Acid the best overall. In the colony counts taken from meats I found Acetic Acid the best in rm.temp. and Stannous Chloride the best in refrigeration. In the home remedies Vinegar was the best in rm.temp. and refrigeration. Concluding Acetic Acid was the best overall.

#Second Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

#DIFFERENTIATING BETWEEN HUMAN AND COW ESCHERICHIA COLI

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Escherichia Coli is used as an indicator for fecal pollution when freshwater is tested for its sanitary quality. In rural areas many freshwater lakes may contain both human and cow E.coli. Today when E.coli is found in freshwater no definite procedure exists to determine if the origin is from residential of agricultural areas. If, when E.coli is found, the origin could be pinpointed, the sanitary quality of the water could definitely be stated and steps could be taken to stop or decrease the incoming pollution from the predominant source of the E.coli. Data from past research showed that patterns of certain sugar reactions, that were contained in a commercial test strip, could be used to differentiate between the two coliforms. This year's research consisted of two phases. In phase one, sugar solutions were used containing five different sugars, bromthymol blue and nutrient broth. In phase two, the sugar solutions contained the same sugars as in phase one and brom cresol purple broth. In both phases, the human and cow E.coli's reaction to the sugar solutions were recorded at different incubation times. The data that was recorded in phase one could not successfully be used to distinguish between the two coliforms. However, the procedure used in phase two did differentiate between human and cow E.coli.

#Scholarship - Ohio State University
Third Award - General Motors ISEF

#PENCILLIUM NOTATUM

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It has been discovered, through previous experimental study that Penicillium notatum colonizes best at a pH of 7.0. It has also been stated that any growth is difficult above the pH of 8.0 or any pH lower than 5.5.

It is familiar to most that bread can be, under certain conditions, a popular feeding and breeding ground for a common mold. This mold, however, is not just any mold, but is a penicillin mold.

By retesting the previously mentioned experiment (paragraph #1), using scientific expermentation and extremely sterile procedures and by carefully analyzing the results - which were quite similar to the earlier experimented upon - it can be determined that the techniques utilized was done properly, precisely and demonstrates true scientific methods.

However, not only is performing proper techniques an importance in this experiment, but also an interesting concept derived from the results. Because of Penicillium notatum's non-colonization in pH levels higher than 8.0 and lower than pH 5.5 and penicillin's growht on bread, "Can it not be hypothesized that, by adjusting the pH level - more acidic or more basic - when making bread, would reduce the formation of mold?"

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/
Patent and Trademark Office Society

MICROBIOLOGICAL, CHEMICAL AND STATISTICS STUDY OF VARIOUS MONGROVES PLANTS SPECIES ACTING AS ANTIBACTIRIAL AND FUNGICIDES AGGENT FOR *A. SOLANI*.

BENNY RIVERA TIRU- DR. PILA HIGH SCHOOL-GUAYANILLA ROAD
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The main purpose of this research is to determine if the leaves extracts of some mongroves species plants have antibactirials and fungicides properties for some pathogenic bacterias and phytopathogenics mold.

The investigation was divided in four phases. The first one was an echological and classification study of the most common mongroves plants in P.R. This study reveeled that they were *R. mangle*, *L. racemose* and *C. erectus*. The second phase consisted of the leaves extracts preparation in differents concentrations using the plants just mentioned. Pure culture medium were also prepare with *M. phlei*, *E. coli*, *K. pneumoniae*, *E. aerogenes*, *B. megatorium* and *A. solani*. Then susceptibility tests were made, humedifying inhibitors discs in the differents extracts concentratios. The results of this test showed that *R. mangle* and *L. racemose* has antibactirials properties for all the bacterias used on the study, but as a greater concentration,greater was the effectiveness. This results was after compared with inhibitor properties of some industrial antibiotics. The results were analyse with the "Analysis of Variance", and it shows that there was not any significant difference in the inhibitor properties between the extracts and the antibiotics. The third phase reveled that the extracts could control the *A. solani* fungus in"vivo". The chemical study showed that the extracts are composed of differents compounds.

# THE P-TRAP, A BACTERIA CAULDRON

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The purpose of this project was to investigate the P-Trap in various households to determine: first, whether P-Traps are vehicles conducive for the growth of bacteria, second, whether such bacteria could be harmful to man, and third, what steps could be taken to prevent the growth of bacteria at such sites.

Water cultures taken from P-Traps at eighteen sites were streaked onto petri dishes, incubated for forty-eight hours and then observed. Gram stains were done to identify the bacteria as gram negative or positive bacilli and/or cocci. Various substances were then used in an attempt to counteract the bacteria, and a variety of tests were undertaken. Further experiments were done to determine whether the bacteria found was pathogenic.

Bacteria was found in the water of all of the P-Traps investigated regardless of whether the water was used daily or left standing in the trap for long periods of time. Fungus was also found at sites where the water was stagnant. The type of soap used did not affect the growth of bacteria. Pathogenic bacteria, Pseudomonads and Morax-Axenfeld bacillus, were found.

Household bleach proved to be the most effective substance in counteracting the bacteria. However, it had only a transitory effect. Within sixteen hours the P-Trap was filled with bacteria.

The piping system from the home to the sewer must be studied and perfected. A pipe using a ball check in reverse could be an alternate to the P-Trap to keep out the sewer gas without retaining the bacteria filled water.

#Fourth Award - General Motors ISEF

# ACQUIRED RESISTANCE OF ESCHERICHIA COLI TO MULTI-GENERATIONAL PARENTERAL CEPHALOSPORINS

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The purpose of this project is to study the acquired resistance of Escherichia Coli bacteria to parenteral cephalosporin antibiotics. This project also deals with the effect that first, second, and third generation antibiotics have on Escherichia Coli. My studies have practical application in modern microbiology and in the treatment and cure of disease at present.

The cephalosporins are very important to beta-lactam antibiotics in clinical treatment of bacterial infections because of their high therapeutic/toxic ratio, stability to beta-lactamase enzymes, and efficacy. Cephalosporins work against bacteria by inhibiting cell wall synthesis.

After bacteria are repeatedly exposed to an antibiotic, the bacteria build up resistance to the agent. In my research of acquired resistance, I found that the most important factor in the resistance of bacteria to beta-lactam antibiotics is antibiotic inactivation by beta-lactamase enzymes. Acquired resistance becomes a clinical problem when an agent can no longer be used because of the degree of resistance built up in the organism. I encountered this problem with cephalothin.

My lab work conducted on Escherichia Coli and the results of my tests of cephalosporins have led me to the conclusion that physicians and patients alike must use antibiotics carefully, because over-use and over-abuse of these antibiotics leads to premature development of resistance in bacteria. I have concluded that judicious use of antimicrobial agents, such as the cephalosporins, could extend their clinical life, so that they can continue to be used in the treatment and cure of disease.

#Alternate to Scholarship - Ohio State University

INDUCING MUTATION IN ESCHERICHIA COLI USING SHORT WAVE ULTRAVIOLET LIGHT AND OTHER MUTAGENS

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The purpose of the preliminary research was to determine the mutagenic effects of short-wave ultraviolet light on clinical samples of Escherichia coli (control group #ATCC 25922-734581). Eosin Methylene Blue (E.M.B.) agar was chosen because the enteric gram negative E. coli bacilli metabolizes E.M.B. agar to a metallic green color from its normal bluish-purple hue.

E. coli was streaked on the E.M.B. media and was exposed to short-wave ultraviolet light at time lengths from 10 to 55 minutes, at 5 minute intervals.

At the exposure time of 10 to 30 minutes, there was virtually no visible evidence of mutation. However, at 35 and 40 minutes, visible effects of mutation became noticeable.At 45 minutes of exposure, most of the bacteria had apparently mutated. Any exposure time greater than 45 minutes was lethal to the E. coli culture.

The bacteria, after mutation, were tested and were found to be clinically the same as the original culture. Therefore, it appears that a holotype of the original, that will not metabolize E.M.B. to the characteristic metallic green color, had been produced.

Present research is involved with other mutagenic agents as well as furthering the research of short-wave ultraviolet light effects on E. coli.

MICROBIOLOGICAL, CHEMICAL AND STATISTICAL STUDY OF MOMORDICA CHARANTIA L. EXTRACTS AND VARIOUS SPECIES OF FUNGI ACTING AS BIOLOGICAL CONTROL "IN VITRO" FOR THE DERMATOPHYTE FUNGI MICROSPORUM AUDOUINII

Rivera, William, Dr. Pila H.S., Ponce, PR 00731;
Urb. Las Delicias N-3, Ponce, PR 00731.

The purpose of this investigation is to determine microbiologically, chemically and statistically, the effect caused by extracts of M. charantia and the capacity of various species of fungi to control biologically, "in vitro", dermatophytic fungi and pathogenic bacteria.

The first phase revealed plant contains 90% water, 9.8% organic matter and .02% of minerals. It also contains chlorophylls A and B and carotene. A statistical study of the opinion of youth on skin infections caused by pathogenic fungi was carried out. Second phase showed extract of M. charantia controls growth of the dermatophytes M. audouinii, I. rubrum and C. albicans. At a 40% concentrations it reduces growth of M. audouinii to half, at 50% inhibits formation of macroconidia and at a concentration of 100% reduces spores (5 x 106) and the fungus almost totally. A 10% fails to inhibit growth of I. rubrum, at 50% inhibits an average of 1.0cm and at 100% with a 2.9cm ring. A concentration range from 10 to 100% inhibits growth of C. albicans with an average of 3.3mm. A statistical analysis showed significant differences between treatments.

In the third phase, non-pathogenic fungi were used as biological controls "in vitro". Results showed A. niger, A. orizae, Cladosporium, Penicillium, Gargonella and Besochalmi have the antagonic power of controlling biologically M. audouinii. In the four phase extracts of M. charantia were tested against 8 types of pathogenic bacteria for inhibitory action. The effects were compared with commercial antibiotics. Extracts was effective against Pseudomonas, Staphylococcus pyogenes and Shigella. More so than Penicillin, Erythromycin and Chloramphemical. It was also effective against Salmonella typhimurium, E. coli and Klebsiella pneumoniae more so than Erythromycin but negative compared to other antibiotics.

Extract of M. charantia can be used as a possible quimiotherapeutic agent against skin infections of M. audouinii, I. rubrum and C. albicans. Said extract can also be used as a natural antibiotic against bacterias used in this study.

STREPTOCOCCAL PHARYNGITIS: EPIDEMIOLOGY AND IMMUNOLOGY

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The results of Phase I indicate effective acquired immunity against streptococcal pharyngitis, contrary to current texts. If there are a limited number of the 70 M types causing strep throat in the semi-isolated population of Millard Co., UT, type specific immunity would be effective. Typing sera are unavailable. In order to determine the number of unique organisms causing strep throat, a new experimental method has been designed.

Procedure: 1. Sera from representive age groups were obtained and frozen. 2. Group A strep were collected by throat swab. 3. Organisms were taken through "Blood Passage" to assure M protein production. 4. Sera were run through "Opsonization" to determine type specific anti-M antibody levels. 5. Cultures of MAST were tested for A grouping by latex agglutination and culture methods. 6. Antistreptolysin O titers were determined by Difco method.

Conclusions: 1. Latex agglutination tests may give results that are falsely positive. 2. Antistreptolysin O titers are above the expected normal range. 3. Of the sera tested, 50% contain opsonic antibodies to organism #5. 4. Streptolysin O and M protein production do not necessarily correlate. 5. Organism #5 is a distinct M type from #1 and #3.

# INTRODUCTION OF THE HAIRY ROOT PLASMID OF AN *AGROBACTERIUM RHIZOGENES* TRANSCONJUGANT INTO *RHIZOBIUM MELILOTI* RESULTS IN AUGMENTED NODULATION OF ITS HOST

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The family Rhizobiacea contains two very well known genera: *Rhizobium* and *Agrobacterium*. *Agrobacterium rhizogenes*, a common soil-inhabiting microorganism, attains entrance into plants via abrasions. This occasionally causes proliferation of secondary roots resulting in a hairy root syndrome particularly in dicotyledonous plants. The syndrome is genetically controlled by a plasmid harbored in *A. rhizogenes*. During root induction a portion of the Ri plasmid becomes integrated into the genome of the plant. The subsequent events are generated most likely by activation of the plant's genes or the expression of the characteristics integrated into the plant's genes of the incorporated T-DNA. *Rhizobium meliloti* is capable of producing nodules on the roots of Legumenosa and of fixing nitrogen during this symbiosis. The *Rhizobium* will permeate the root hairs and stimulate mitotic activity resulting in root nodules. Along with the host tissues the bacteria carry out symbiotic nitrogen fixation, and gaseous nitrogen can be converted to nitrates which can be utilized by the plant.

Conjugation between *Escherichia coli* 1830, a coliform bacteria found in the intestine, and *A. rhizogenes* occurs. *E. coli* carries a kanamycin-resistant transposon in its plasmid and sometimes transfers that transposon into the genome of *A. rhizogenes*. Some *A. rhizogenes* transconjugants enhance root proliferation as evidenced through a carrot assay and also exhibit kanamycin resistance gained from *E. coli* 1830. This kanamycin resistance provides a method of differentiating *A. rhizogenes* transconjugants from the wild strain. A transconjugant was selected to transfer its hairy root plasmid into *R. meliloti* through conjugation. This increases root nodulation and hence nitrogen fixation.

#First Award - General Motors ISEF

PREVENTING SEPSIS IN BURN PATIENTS

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A four year project. The first three years are combined. I tested Pseudomonas Aureginosa,Candida Albicans, and Staphlococcus Aureus with Staphene, Hibiclens, Betadine, common soaps, and Purex. Soap concentrations of 1-1, 1-5, and 1-10 were incubated with .1cc of the organism in test tubes. Plates were streaked with the concentrations and incubated for 24 hours. Results were: Staphene inhibited all organisms, Hibiclens inhibited all except staphlococcus, Betadine and Purex inhibited all except Pseudomonas, and common soaps did not inhibit any. I concluded that: Staphene is excellent to clean hospital facilities, Hibiclens would be good except it is too harsh on the patients' skin, Betadine would be good except it causes iodine poisoning, and common soaps are not effective. Purex is the most effective and safest to use to bathe the patients. My fourth year project: Do Topical Agents Mixed With Antibiotics Inhibit The Growth Of Sepsis-Causing Organisms Better Than Topical Agents Alone? I tested Sulfamylon, Silver Sulfadiazine, and Garamycin with Amphotericin, Amikacin, Vancomycin, Cefobid and a control against Pseudomonas, Candida, and Staphlococcus. Mixture of 1cc topical agent and 1cc antibiotic was placed in wells of BHI plates. The plates were innoculated and incubated for 24 hours. The results were: More than three-fourths of the mixtures worked better than the topical agents alone. Conclusion: Mixing the topical agent with the antibiotic offers a definite advantage in controlling in-vitro microorganisms than the use of the topical agent alone.

#AN ASSESSMENT OF THE BACTERICIDAL EFFECTS OF SINGLET OXYGEN *IN VITRO*

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1866 Skyline Dr., Greenwood, IN 46142

Singlet molecular oxygen is a very reactive excited state of the oxygen molecule. Evidence for its production in leukocytes during phagocytosis has been reported by several researchers; consequently, it has been postulated that this molecule might participate in bacterial killing in the phagocyte. However, the possibility that singlet oxygen may act as a microbicide has never before been examined; thus, the purpose of this research was to examine the possible bactericidal activity of the excited singlet oxygen molecule.

Singlet oxygen was tested for bactericidal activity against *Escherichia coli* and *Staphylococcus aureus*. Dye photosensitization was used to produce the excited oxygen: methylene blue (MB) was added to suspensions of E. *coli* and of S. *aureus*, which were then illuminated by a non-germicidal fluorescent light source. Control groups consisted of (a) illuminated suspensions which did not contain MB, (b) MB-containing suspensions which were kept in darkness, and (c) illuminated MB-containing suspensions to which diazabicyclo(2.2.2)octane, a singlet oxygen quencher, was added. Plate-count tests of bacterial viability revealed that illuminated, MB-containing (experimental) suspensions of both species experienced at least 50% reductions in numbers of viable organisms when compared to controls.

E. *coli* and S. *aureus* suspensions exposed to a singlet oxygen-producing system were found to have significantly fewer viable organisms than otherwise identical control suspensions. Further, a singlet oxygen scavenger eliminated the reduction in viability induced by the singlet oxygen system. It is therefore concluded that singlet oxygen does exhibit bactericidal activity against E. *coli* and S. *aureus*.

#Third Award - Sigma Xi, the Scientific Research Society

Fourth Award - General Motors ISEF

THE COMBINED TROPISM TO LIGHT AND MAGNETS OF SYMBIOTIC PARAMECIUM

Hollums, Jay, Floydada High School, Floydada, Tx. 79235;
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The experiment was run to find if there are any significant differences in responses to magnetism and light between symbiotic and nonsymbiotic paramecium. Two identical tubes were made, and each paramecium type was placed in each of the tubes. The control tube had no magnet on either end; the experimental tube had a 100 gauss magnet at one end. Light filters of white, blue, and red were used on top of both tubes. The same position for all materials was consistently used in all test. A set of 60-watt bulbs provided light, and 22°C in the small room provided further controlled conditions. After 30 minutes, counts of paramecium from each end of the 2 tubes were made. 240 total counts were analyzed to obtain the t-test results and probabilities. The symbiotic paramecium showed significance above $p=.01$ for all light tests, and they preferred to come to the magnet end; whereas the nonsymbiotic paramecium showed no significance and could be almost equally found at either end of the tube.

These results suggest that, on a cellular level, light-dependent cells interact with non-light dependent cells to show a significant magnetic attraction. Other research articles suggest this attraction is caused by an electro-chemical gradient created by the photosynthesizing cell that then changes the ionic membrane channels of the paramecium and thus causes them to move to the magnet. The application of this project is that it suggests the use of symbiotic organisms in experiments investigating the interaction of magnets, light, and photosynthesis on cellular membranes.

HERBICIDAL EFFECTS UPON SOIL BACTERIA-A 2 YEAR STUDY

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A herbicide is a substance used to kill weeds or inhibit their growth.

The use of herbicides today is very extensive. The problem that I am investigating concerns what possible effects this extensive herbicidal use is having on the normal soil bacteria.

Hypothesis: The herbicides in use today are killing our soil bacteria, which are absolutely necessary for all processes carried out in the soil.

While evidence shows that the bacteria do return after the disappearance of the herbicide, long term use of herbicides without the practice of summer fallow and other good farming practices may have a detrimental effect on the bacteria of the soil.

To test this hypothesis I experimented with 3 different tests: Isolated soil bacteria incubated with sterile soil for 48 hours; Isolated soil bacteria with sterile soil-herbicide applied; Serial Dilution Test.

From my results I concluded that the herbicides in use today are definitely having a damaging effect on the normal soil bacteria. However, the residual effects of the herbicides do not seem to be very great. After a 48 hour time period, the bacteria were beginning to return.

The long term effect of herbicides is yet to be seen. I feel that we must start conserving and protecting our soil now, before it is too late and we find our soil worn out because of extensive use of chemicals and poor farming practices.

#ACCLIMATION OF THE ANAEROBIC METABOLIC CYCLE IN SACCHAROMYCES cerevisiae AT SUBSTANDARD TEMPERATURES FOCUSING ON FATTY ACIDS: THEIR INTERRELATIONSHIPS WITH THE CELLULAR MEMBRANE AND DNA

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Finding a yeast that ferments at a substandard temperature could have a dramatic effect upon the wine industry: wines left to ferment at substandard temperatures acheive a fruitier taste and thus become better wines (Kunkee, 1985).

Phase (1) dealt with the acclimation of Saccharomyces cerevisiae to a substandard temperature with the hope that the length of the anaerobic cycle would increase. Strains were adapted to low temperatures by a process of natural and artificial selection (selection after photoionization). Observations after a series of generations illustrated that the yeast was able to acclimate to suboptimum temperatures, in terms of 1) observable growth and 2) fermentation capacity.

Phase (2) delved into finding the means of low temperature adaptation on behalf of S. cerevisiae. For purposes of experimentation the amount of exocellular fatty acids produced would be tested against the amount of adaptation each yeast had undergone. Analysis by liquid-gas chromatography illustrated that the levels of exocellular fatty acid in the must of the latter generation yeast cells was lower in contrast to the levels found in the must of the parent controls.

Phase (3) was concerned with finding whether decreased fatty acid production was directly controlled genetically or whether it was a function of a shift in metabolic pathways. A fourth-generation Epernay wine yeast was mated with an auxotrophic mutant of S. cerevisiae. After tetrad analysis, there was no observable Mendellian inheritance pattern for fatty acid production.

#Trip to CONUS Laboratory - United States Navy/Naval Medical Research and Development Command

Second Award - General Motors ISEF

PSYCHONEUROIMMUNOLOGY: REPRESSION OF THE IMMUNE SYSTEM BY AN IMMUNOSUPPRESSANT COUPLED WITH PSYCHOLOGICAL CONDITIONING

Anderson, Tamila E., Nicholas County High School, Carlisle, KY 40311
Old Paris Rd., Carlisle, KY 40311

The immune system has always been thought to act independently of mind related stimulus. However, there has been, in recent years, evidence supporting the theory that this system may indeed be linked to psychological control. Psychoneuroimmunology is the basis for this research, which attempts to suppress the immune system by conditioning mice with an immunosuppression drug.

Four groups of mice were used; control, conditioned, residual (to determine any residual effect of the drug), and unconditioned. Results showed the antibody titer of the control mice to be high in response to the SRBC antigen. The conditioned group suppressed their immune systems to the antigen in response to conditioning with a taste aversion.

Unconditioned animals displayed extremely low antibody titers verifying the results of the drug in its activity.

The t-Test was used to compare means of all groups to control group. Results were found to be significant.

DETERMINING THE MOST EFFECTIVE ANTIBACTERIAL SOLUTION AND COMPOUND

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The purpose of this 2 yr. project is to determine the most effective antibacterial solution and compound. The 1st yr. 7 cleaning solutions were tested. Bacteria collected from a bathroom sink were streaked onto a blood-agar petri dish. From this dish, Staph. epidermidis and Staph. aureus were isolated and streaked onto 16 other dishes. At the same time, a piece of filter paper which had been soaked in a cleaner was placed in the center of each dish so that each cleaning solution was tested with both types of bacteria. The effectiveness of each cleaner was determined by measuring the distance from the edge of each filter paper to the first bacteria colonies. The following is a list of the cleaners beginning with the most effective: Boraxo, Clorox Bleach, generic bleach, Lysol, Pine Power, Tile Plus, Parson's Ammonia.

This year the purpose was to determine the signifiance of sodium chlorite in the top 4 cleaners, and determine if $NaClO_2$ is the most active of the compounds comprising the 7 cleaners. The active compounds were isolated and tested in the same manner as described above. Sodium chlorite was found to be the most trenchant compound and was followed by phenol, ethyl alcohol, and ammonium hydroxide. In conclusion, Boraxo Tile Cleaner and sodium chlorite are the most effective antibacterial solution and compound. Secondly, the concentration of sodium chlorite must be higher in the Boraxo Tile Cleaner than in Clorox Bleach,generic bleach, and Lysol because Boraxo is the more effective cleaner.

Hopefully this study will incurage consumers to use Boraxo Tile Cleaner in their homes, and cut down on the diseases caused by Staph. epidermidis and Staph. aureus. This information should also encourage future producers to use only the most trenchant antibacterial compounds in their disinfectant produts.

TESTING FOR ANTIBIOTIC BACTERICIDAL PROPERTIES IN DIFFERENT SPECIES OF FUNGI

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The purpose of this project was to test different species of fungi such as Mucor, Nigrospora, Penicillium, Rhizopus Aspergillus, to name a few, for bactericidal properties.

Considering the number of species of infectious microorganisms it is necessary that we constantly seek ways of preventing infections caused by pathogenic microorganisms in other organisms.

Using Czapek's medium, different species of fungi were grown in culture from different sources of inoculum. The initial mixed cultures were continuously subcultured until pure strains were obtained. At the same time, cultures of Staphylococcus Aureus, Streptococcus Faecolis, Escherichia Coli, and Psendomonas Fluorescens were grown at the University of Arkansas at Pine Bluff under the direction of Dr. Fitzpatric, Associate Professor of Biology. Four sets of nine petri dishes, each containing nutrient agar were used to culture the above mentioned bacteria. Each culture was then inoculated with one of the nine test fungi. The cultures were allowed to grow undisturbed for three days before making initial observations. Several of the test showed a definite ability to inhibit the growth of bacteria in culture in varying degrees.

As the testing continues I will make additional observations with the hope of identifying those species of test fungi which exhibited bactericidal properties against known species of infectious microorganisms. My hypotheses is that some of my test species of fungi will exhibit an unknown ability to inhibit the growth of a bacterial population. Such findings, I believe will have an immediate impact upon the treatment of some disease agents.

# MUTAGENESIS OF THE MITOCHONDRIAL GENOME OF S. CEREVISIAE BY THYMIDINE 5' - MONOPHOSPHATE

Thomson, Rachel J., A.N. Myer S.S., Niagara Falls, Ont., Canada L2J 1M7
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The object of this study was to determine if high concentrations of thymidylate present in the growth medium were mutagenic for the mitochondrial genome of the baker's yeast Saccharomyces cerevisiae. Exponential yeast cells were harvested by centrifugation and resuspended in complete medium containing various concentrations of dTMP. After 24 hours of growth, the cells were counted in a Coulter counter and spread on agar plates containing the antibiotics chloramphenicol (CAP) or erythromycin (ERY). Cells were also plated on the same medium without antibiotics to monitor the number of respiratory proficient cells in the population. Following 5 to 7 days of incubation at 30oC, the plates were scored and the frequency of CAP resistant or ERY resistant mutants was determined.

Experimental results indicated that the frequency of antibiotic resistant mutants in the cell population increased with increasing dTMP concentration, so that at the highest concentration of dTMP tested, the frequency of CAP resistant or ERY resistant mutants had increased by 300 fold and 400 fold, respectively.

These results suggest that high concentrations of dTMP are very mutagenic in the mitochondrial genome of yeast. It is likely that the mode of action of dTMP is to interfere with the fidelity of DNA replication. Uptake of dTMP may lead to very high intracellular pools of dTTP. Thus, during DNA replication there is an increased likelihood of mistakes in replication leading to GT mismatches. As thymidine is commonly used in cancer chemotherapy, and if it can be shown that the human mitochondrial genome is similarly mutagenized, these results have important clinical implications, especially for women, as it is likely that the mutations thus induced would be inherited in a maternal fashion.

#Fourth Award - General Motors ISEF

Mapping a DNA Repair Deficient, Recombinant Defective, E. Coli Mutant

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The base excision repair pathway allows viruses to survive at a frequency of 1%. Viruses transduced into four (4) hyper-recombinant derivitives of KS391, however, show only a .1% survival rate. Three of these repair deficient, recombinant defective mutants have been mapped to their respective locus on the genetic linkage map (E. Coli chromosome). The object of this study is to obtain more knowledge about the 4th strain isolated which is classified as RSS455.

These mutants, which decrease the survival rate of viruses existing in them by over tenfold, might possibly be simulated in human cells by mutation. This may result in a weakening of viral contained cells and, thereby, help to fight against viral infections or the development of cancer.

My first goal has been to locate the mutant's position on the E. Coli chromosome. Doing so will help to determine the mutant's specific characteristics and its biochemical lesion.

Mapping the mutant is being undertaken by standard Hfr conjugations and PI transductions. Hfr conjugations are successful in locating the general chromosomal region where the mutant is located. PI transductions enable mapping to continue on a more precise level.

As a result of these experiments the E. Coli mutant classified as RSS455 has successfully been mapped between the region of 88 to 91 minutes on the genetic linkage map.

In conclusion, there is a high possibility that this E. Coli mutant contains a new, undiscovered gene, causing its genotype, which may serve to alter the base excision repair pathway.

MONOCHROMATIC PHOTOREACTIVATION OF ESCHERICHIA COLI AFTER U.V. IRRADIATION;

Boles, Amy; Liberal Senior High School, Liberal, KS 67901; RR 1, Box 209, Liberal, KS 67901

It has been established that certain wavelengths of ultra violet radiation are lethal to Escherichia coli. Preliminary investigation by this researcher supports A. Kelner's results of lethal reversal by white light. Since white light is made up of varying wavelengths, it was hypothesized that monochromatic photoreactivation was possible. Results support this hypothesis and indicate that the blue end of the visible spectrum gives greatest lethal reversal.

# ALTERNARIA FUNGUS AS A POTENTIAL BIOLOGICAL CONTROL OF LEAFY SPURGE (EUPHORBIA ESULA)

Creech, W. Jeb. Bismarck High School, Bismarck, N. D.
619 N. 6th Street, Bismarck, North Dakota 58501

During the summer and fall of 1985, isolates of Alternaria sp. fungus were obtained from diseased leafy spurge plants. Tests for pathogenicity were demonstrated in greenhouse, laboratory, and limited field studies. The results indicated that Alternaria fungus can be considered a potential biological-control agent for leafy spurge. This project was conducted to determine whether Alternaria fungus, isolated from leafy spurge was pathogenic to leafy spurge. A pathogen of this sort might play a major role in controlling leafy spurge in areas where herbicide use is not feasible due to large acreages, endangerment to plant and animal life, windbreaks, and waterways.

#Second Award - American Phytopathological Society
Second Award - General Motors ISEF

CROSS-INFECTIVITY OF GIARDIA DUODENALIS FROM HOMO SAPIENS TO GERBILLUS AND MUS MUSCULUS AND THE RESPONSE OF TROPHOZOITES TO IN VITRO DRUG APPLICATION.

GIRARD, SUSAN L., BRADFORD AREA HIGH SCHOOL, BRADFORD, PA 16701;
BOX 301, LEWIS RUN, PA 16738

This study examines the transmission of Giardia duodenalis from Homo supiens to Gerbilius gerbillus and Mus muscullus - cysts which were isolated from humans and transmitted to gerbils were then passed to mice. Trophozoites from the infected mice were studied for their in vitro response to quinacrine (Atabrine) and Metronidozole (Flagvl).

THE EFFECTS OF HOUSEHOLD SUBSTANCES ON TERMITE-DWELLING FLAGELLATES

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This project was performed to discover the responses of flagellates, located in the termite gut, to various household substances. The substances were administered to a wet-mount prepared of the flagellates. It was discovered that ammonia, vinegar, and Lysol killed all the protozoa, while epsom salts killed seventy-five percent, spic and span killed fifty percent, and the wesson oil killed none. It was concluded that ammonia, vinegar, and Lysol could be a possible termite treatment. Further tests will have to be performed to determine whether or not the substances are economical, to find out how they affect wood, if the substances kill the termites themselves, and if the treatment is feasible. The answers to these questions will help determine if these products can be used as effective termite treatments.

PHYSICS

VARIABLES AFFECTING THE MEANDERING OF WATER

Kari Sonnichsen, Patrick Henry Junior High
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Sioux Falls, SD 57105

What causes water to meander down window panes?

Research: When it rains outside, water runs down the window panes. John C. Scott and people at Takeo Nakagawa of Kanazawa University of Japan made a stream of water flow along a smooth plate of Plexiglass. It was found that when the Plexiglass was tilted more than 30 degrees from horizontal, the stream of water formed a steady meander.

Hypothesis: Water meanders down window panes when the quantity and velocity of the water is fast and full or small and slow and the angle of the glass is less than 80 degrees.

Purpose: Performing this experiment will demonstrate that water meanders down windows, and that the angle of the glass and velocity of the liquid affects the meandering.

Procedure: The experiment was conducted as follows:

1. An apparatus was made for studying the effects of water meandering down glass.
2. Water was tested at five different angles with different flow rates and quantities of water. The amount of meandering was recorded.
3. The results from each trial were recorded and compared.

Results: The water at 80 degrees stayed close to the center black line all the way down the glass. The liquids meandered more as the slope decreased and became smaller. Gravity played a part in the meandering of the water.

Conclusion: The amount of meander varies according to the slope of the Plexiglass. The quantity of the water also affects the meandering. The velocity of the water also affects the meandering. A discrepancy occured at 5 degrees.

# MEASURING BROWNIAN MOVEMENT: A TWO YEAR STUDY

Stryker,III, Judson P. (Jay), Mainland S.H.S., Daytona Beach,
FL 32014; 35 Mayfield Circle, Ormond Beach, FL 32074.

Brownian movement is the irregular motion of nonliving microscopic particles caused by thermal motion of the molecules of the material in which the particles are placed. The particles will randomly collide with the molecules of the substance which will give energy and momentum to the particles. What effect will temperature change have on particle collisions and can the movement be measured using current technology?

In my science project I have used modern electronic equipment and have found an accurate method of measuring thermal movement of microscopic particles. Results suggest that velocity changes exponentially with temperature change. This information may be beneficial to environmentalists, physicians, manufacturers and other researchers who are interested in the extent of diffusion and osmosis of chemical products.

#Scholarship - University of Alabama in Huntsville

# NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY IN HIGH POLYMERS

Rhee, Sharlyn S., Whitney M. Young H.S., Chicago, IL 60607;
4640 N. Sheridan Rd.(Apt. 1401), Chicago, IL 60640

NMR is a technique used to study the molecular structure of matter. In theory, it is possible because of the dipole properties exhibited by magnetically active protons such as Hydrogen-1. The practicality of the NMR method, on the other hand, is due to the observed features such as chemical shifts, splitting patterns, and the integral. They respectively yield information about the sample's constituents, its geometrical structure, and the amount of each constituent.

In the experiment, three samples of polymethyl methacrylate of varying tacticities were prepared and run through the NMR spectrometer. The resulting spectra were examined with reference to the researcher's previous data. Then using the integral, the particular tactic nature of each sample was confirmed. In the process, correlation between the theory governing NMR and its practicality was established.

#Fourth Award - General Motors ISEF

# CONSERVATION OF ANGULAR MOMENTUM: A DEMONSTRATION AND VERIFICATION

Atkins, Terence, Northwest High School, Omaha, NE 68134;
8811 North 57 Street, Omaha, NE 68152

This project is designed to prove conservation of angular momentum. The angular momentum for the cars on a suspended circular track moving one way was shown to be very nearly the same as the angular momentum for the track going the opposite way. Two different mass configurations were tested. The difference between the initial and final angular momenta ranged from 0.4% to 6.9%. It can be used as a class demonstrator to show that when a runner accelerates one way (along a latitude line) the earth accelerates the other way. It shows dynamic balancing as performed when balancing an automobile tire. Also, by setting the frequency of the cars moving around the track slightly different from the natural pendulum frequency of the track, a mechanical analogy of wave beats can be demonstrated.

#First Award - American Association of Physics Teachers
Fourth Award - General Motors ISEF

# CORRELATION OF THE FRENCH HORN AND A CONICAL PIPE

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2540 Swan, Springfield, MO 65807

The purpose of this investigation was to determine the cause of the drop in pitch when the French horn is fully stopped. The first step was to prove that the pitch actually drops, and to dispel the prevalent belief that the pitch rises. This was done by inserting the right hand into the French horn bell while recording the results on both a frequency counter and an oscilloscope. Evidence supports that the horn behaves like a strictly conical pipe, both when open or stopped. Through mathematics, it was shown that the bell had no effect on the pitch of the horn. Backing this, frequency readings were taken on a horn with the bell attached and unattached, along with locating the acoustical energy barrier inside the bell with electronics. Further work was done in a wave tank to study the acoustical barrier and the wave behavior of a closed cone. A new formula is proposed from the data of the previous horn-stopping experiment, which was found by measuring the unknown resonant frequencies by phase shift measurements. Experimental values show this formula to be accurate to within two percent error. The formula needs to be studied mathematically, but it still stands as a useful formula to any closed-cone application. Not only has this project help solve the long unanswered question of why the pitch drops when the horn is stopped, it also derives a simple formula that has been previously unknown or at least unclear.

#First Award - Acoustical Society of America
Second Award - General Motors ISEF
Alternate to Scholarship - University of Alabama in Huntsville
Third Award - Ball Electronic Systems Division and Ball Aerospace Systems Division

#WHAT IS THE BEST CONCAVE DESIGN FOR WATER SKIIS

Ron Thompson, Nitro High SChool, Nitro, W.Va. 25143
5420 Alpine Drive, Cross Lanes, W.Va. 25313

After proving that the concave design for water skiis was superior to flat bottom designs, I researched and found that there hadn't been any changes in bottom designs of concave skiis. I then proceeded in the designing of a new concave ski design. I came up with over 30 designs, then after evaluation and testing, narrowed it down to two different designs. I tested these two skiis against the type of concave ski manufactured today, all 1/5 scale size. I tested these skiis in three areas: surface tension, friction and stability. All tests were conducted at a scale speed of 22.5 mph. The results of these tests proved that one of my ski designs was far superior to the design of concave ski manufactured today. Thus making my ski design easier for beginners to learn on and enable professionals to ski further up to their potential. As a secondary result of my research, I designed a new boat hull which combines the strength of deep V hull and the speed of a tunnel hull. Making a boat faster than a deep V and stronger than a tunnel hull.

#First Award - Allegheny International
Fourth Award - General Motors ISEF

IS THERE A SECRET DIRECTION TO CONDUCTIVITY?

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To discover why resistance in a magnet varies when the current is reversed and/or the direction is changed and to prove the general law "resistance varies as its conductor's length" remains true, even when the conductor is a magnet are my purpose. I created a circuit using thin copper wire, touching the sides of the bar magnet, held by alligator clips that were connected to an energy source and an ampmeter. Using constant voltage and the true north and west directions, I measured the resistance of a magnet due to its direction, reversed the current, and repeated the former. My data showed that there is more resistance when the magnet is pointing north than west and that there is more resistance when the positive terminal is connected to the left side of the magnet. Using a known formula, I calculated K (magnet's constant) and diameter of each magnet for each variable. From ratios constructed from my data, I concluded that the diameter of the current varies according to the direction the magnet is pointing therefore causing the K and resistance of the magnet, which are constant, to change. Also, by using the calculated length, resistance, and diameter of each magnet in the magnetic field intensity formula, I found that there is no magnetic field on the surface of a magnet with an electric current flowing through it. Therefore, the earth's magnetic field has a greater influence on the magnet's and current's magnetic fields.

THE EFFECTS OF OPPOSING MAGNETIC FIELDS AS A RESULT OF INUCED ELECTRICAL CURRENT.

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311 SW 6th St., Dimmitt, TX 79027

Due to the work or Oersted, which showed that an electrical current could produce magnetic lines of force, scienteets have been interested in the results of this effect. Michael Farady concluded that if an electrical current can cause a magnetic field to be formed, a magnetic field could produce an electrical current. Later H. F. Lenz studied the effects of an electrical current flowing through a wire wrapped around a soft iron core. As a result of this, a magnetic field would be established around the core. He also observed what would happen if a non-magnetic conductor was placed in this field. Lenz's Law states: that the induced EMF, in a circuit, is in such a direction as to oppose the change causing it. In particular, the induced EMF, is directed such that the current it tends to generate would produce magnetic flux link- the circuit in such a way as to oppose the change in magnetic flux causing the EMF.

The repulsion coil is an excellent instrument to study this effect. The coil was built so as to test two different strengths of induced EMF. There are 150 turns and 400 turns of copper wire wrapped around an iron core. Also I tested different metals to see if the same induced EMF could be produced.

THREE-DIMENSIONAL PLOTS OF NUCLEAR ENERGY CHANGES

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In this project, a method was developed by which three-dimensional plots of nuclear energy changes were generated using a Fortran computer program. The physics of the program calculations is taken from a current nuclear model known as the Dynamic Deformation Model. Two-dimensional energy contour plots and three-dimensional plots were produced. As a result, changes in nuclear shape that heavy nuclei (such as Pu-240 or Fm-256) undergo as they gain or lose potential energy were pictured. Thus, the plots help to visualize how a nucleus elongates and finally splits in the fission reaction. More importantly, these plots should prove useful in the current search for superheavy nuclei (new elements). Since each possible element is characterized by a different plot, heavy mass elements could be arranged in a " Δ MeV Table" ; this table could be used (in the manner of Mendeleev's periodic chart) to predict the properties of undiscovered superheavy elements. Specifically, the plots relate three properties of a nucleus: oblateness, elongation, and potential energy; therefore, two of the three variables are sufficient to identify a new element. If experimental techniques can be devised to measure the changes in shape of a nucleus, the energy of the nucleus could then be calculated, a plot produced, and a comparison with known plots made. In this manner, a new element could be identified. Optimistically, this method of producing three-dimensional plots of nuclear energy changes can be published and used in research into the transuranic elements.

#THE PREPARATION OF ELECTRICALLY CONDUCTIVE POLYANILINE

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I attempted to produce an electrically conductive, stable, organic polymer. I chose to try to produce an electrically conductive form of polyaniline. The polyaniline was polymerized by ammonium peroxydisulfate, an oxidizing agent. While being polymerized the polyaniline was subjected to the presence of a dopant, usually HCl or KOH. After polymerization the polymer was filtered and again doped with the same dopant. The resulting solid was then dried under dynamic vacuum. The remaining solid was crushed with a pellet compressor into a cylindrical shape. A self designed Pellet Resistance Sensor was used with a multimeter to measure the resistance of the pellet. The conductivity of the polyaniline could then be calculated. The substances formed in just water had a conductivity of 10^{-6} mho/cm; the HCl doped polymers were in the 10^{-1} mho/cm range. Other forms had conductivities as low as 10^{-11} mho/cm. Over a year's time the conductivity of three of the first conductive forms made showed virtually no change in conductivity. The technological promise of a conductive polymer that is stable in air and that has such a great range of electrical conductivities is great. A polymer with these properties, such as polyaniline, could replace more expensive, heavier metals in light-weight batteries, solar cells, and electronic circuitry.

#Second Award - American Association of Physics Teachers
Third Award - General Motors ISEF

#ELECTRODEPOSITION OF CALCAREOUS MATERIALS

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The purpose of this investigation was to determine the effects of running a direct current (D.C.) between two electrodes in seawater. The experiment was performed at Florida Atlantic University under controlled conditions and later continued at the Pennel's Marina under natural conditions.

Two steel bars were set up to have an electrical current running between them at an average of 0.13 amperes. The result of this was an accretion.

Four steel bars were then set up with an average of 0.20 amperes. The accretion of the two cathodes joined, forming a solid accretion. This is the start to forming a usable wall.

Electrochemical accretion produces accumulated matter consisting of calcium carbonate, silicon dioxide, magnesium hydroxide and other materials.

Building and repairing seawalls and footwalls are an application of this project. These walls aid in detering erosion by acting as the intervening agent between the shoreline and the water. It is an expensive procedure to build and maintain seawalls and footwalls using present construction methods. However, electrochemical accretion can provide a less costly construction method of building and repairing seawalls and footwalls.

Electrochemical accretion can be used in the prevention of beach, canal and river erosion.

#Honorable Mention - American Intellectual Property Law Association

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FINDING THE EFFECT OF GRAVITY UPON TURBULENCE

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Knowing how gravity affects turbulence would aid the study of turbulent events occuring in different gravity conditions, such as solar flares or pumping spacecraft fuel in orbit.

This project is an experiment designed for flight aboard a Space Shuttle. Its purpose is to discover what effects gravity has on turbulence. The experiment would show how changes in gravity would alter the amount of turbulence and how gravity would cause turbulent patterns to differ.

Dye would be injected into a tank with water flowing through it. The flow would become turbulent downstream when it encounters an obstacle. The tank would be observed in earth's gravity and in zero gravity aboard a Space Shuttle. To record the turbulence in the tank, cameras would be used. Resulting differences in turbulence would be compared to find the effect of gravity. In this experiment, variables are gravity and turbulence.

Data resulting from the experiment would be analyzed primarily in the following ways: 1) slow motion replay, 2) superimposed freeze frames, 3) normal speed replay would be used to examine the movement layers, in different gravity strengths and 4) volume and density of the turbulence in different gravity environments would be compared.

In connection with the project, predictions have been made about the results of the experiment; and a mathematical formula has been created that can be used to find the relative turbulence of any flow in any gravity conditions, assuming the hypotheses are true.

# THE FORMATION OF CRYSTALLINE AND AMORPHOUS NICKEL CLUSTERS

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In this project, a molecular dynamics computer simulation of small clusters of nickel atoms was performed. Nickel clusters four to fifty atoms in size were modeled on computer using the Morse pair-potential to describe interactions between all individual pairs of nickel atoms within the clusters. In order to approximate the integration of Newton's laws of motion, the Nordsieck method was used, and it was found that an accurate approximation was obtained only when a time interval of 1 femtosecond was used in the calculations.

The simulation for each droplet was begun from an asymmetrical, unrelaxed FCC lattice configuration. The configuration was first allowed to achieve an equilibrium state. Heating to a liquid was then simulated by scaling the velocities of the atoms in the cluster. When the clusters reached 1600K, the cooling of the clusters at various rates was simulated.

Clusters 4, 5, 6, 7, 8, 10, 12, 13, 16, and 20 atoms in size were tested in this manner. The effect of cooling rate upon the total potential energy of the solid was observed, and the significance of cooling rate upon stability was compared among the differently sized clusters. It was found that only the larger clusters were affected significantly by cooling rate. The smaller clusters did not display a significant correlation between cooling rate and structural stability.

This work may be applied to the study of the change in phase from the liquid to the solid state, and the production of uniform lattices of many solids.

#First Award - General Motors ISEF
First Award - United States Air Force
Alternate - American Committee for the Weizmann Institute of Science
Second Award - BDM Corporation

A STUDY AND CONSTRUCTION OF COST EFFICIENT SOLAR CELLS

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125 East Flynn, Harlingen, TX 78550.

The main purpose of this project is to experiment with a silicon solar cell observing its functions thoroughly and then, to try to develop a solar cell composed of other materials which is more efficient and cost less to manufacture. Its first objective is to examine the sensitivity of light upon a silicon solar cell as to distance variation, intensity, angle of contact, and type of light source used. The second phase of this project deals with the development of a cost efficient solar cell. Possible materials which are being used to make these cells are organic and metalic materials.

This project confronts the difficult construction of such solar cells as silicon solar cells. It attempts to find ways to develop distinct P-N junctions between materials which may be in solid or liquid forms. Varnish, plastic cement, and jelly-type substances have been mixed with P-type and N-type materials to create P-N junctions. The procedure in which to make these cells is still under examination and process.

#A REPRODUCTION OF MILLIKAN'S OIL DROP EXPERIMENT -- A PRELIMINARY STEP IN THE SEARCH FOR THE FRACTIONAL CHARGE

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In 1909, American physicist R. A. Millikan used a greatly modified Wilson cloud chamber to suspend a charged oil droplet by means of an electric field. With his apparatus, Millikan could determine the charge of a single electron by measuring different droplet charges and finding the common factor. This was the first accurate and precise measurement of _e_. My purpose here is to reproduce Millikan's experiment and to support his results. On a broader scale, I intend to build an automated Millikan apparatus this summer (1986) and accumulate a large number of data points in hopes of observing a fractional charge or free quark. I choose to pursue this because of the apparent controversy over the fractional charge's existence that has been evident recently and because Millikan's method is relatively easy to automate. The procedures are simple. The experimenter can measure the terminal velocity of a charged droplet by timing its freefall and upward motion (under the influence of an electric field) over a distance set by hairlines in a microscope eyepiece; or he/she can vary the field strength until the selected droplet comes to a complete halt. Either method can be used. In my first run, I utilized the first method described and found _e_ to be $(4.78 \pm .07) \times 10^{-10}$ esu. The data supports the quantization theory adequately. As mentioned above, I plan to automate the apparatus with a computer so that I can search for a fractional charge. In short, I will modify an old method to attempt to answer the modern question, "Does the fractional charge exist?"

#Alternate to Scholarship - Ohio State University

A HAIR AFFAIR - TESTING THE TENSILE STRENTH OF HUMAN HAIR

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The original purpose of this experiment was to determine what effects certain hair products and styling appliances have on human hair. To determine this, the tensile strength of the hair had to be determined by means of elastic displacement to a graphed calibration chart.

Different hair products and brands of products had different effects on the hair, ranging from good to bad. For example, it was discovered that the shampoo regularly used on the hair was causing the hair to lose much of it's natural moisture, greatly reducing the tensile strength. The average stretch of the hairs in this sample was 1.7mm. Also determined was the fact that hot oil treatments replenish natural hair oils, which aid in preventing moisture loss in the hair. Hot oil treatments, therefore, improve the elasticity and tensile strength of the hair shafts. These samples averaged at a 13.7mm stretch.

This experiment aided greatly in learning how to improve the physical appearance of the hair, and was also source for obtaining knowledge about the proper use, care, and management of styling appliances and products.

#JET NOZZLE EFFECTIVENESS

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The purpose of my project is to determine which, of a group of differing lead nozzles, is the most effective in converting a given mass-flow of exiting steam into thrust.

To carry out my experiments, I constructed a "rocket" out of a rectangular cake pan whose top was closed off with aluminum and sealed. A single hole was punched into the far end, onto which could be fitted the rectangular cubical nozzles cast out of lead. One cup of water is poured into the sealed cake pan, and the whole apparatus is suspended above flaming alcohol, which boils the water causing steam to escape through the nozzle. This rush of steam creates a thrust which causes the rocket to rotate. Thus, I used revolutions per minute (RPM) as the relative unit for thrust throughout my experimentation.

The variables I investigated using the nozzles were: 1) how differing exit widths of straight, tunnel-exited nozzles rank according to individual effectiveness; 2) how the length of the nozzle itself affects thrust output; and 3) how the differing throat widths in diverging-exited nozzles affect thrust output. I also performed auxiliary experiments of pressure and temperature, the former at least in part supports my results from the rocket experiments.

Basically, I found that the nozzles with smaller diameter exit tunnels worked more effectively than the nozzles with larger diameter exits. The longer nozzles were more effective than the shorter ones, and, as a whole, the diverging nozzles worked less effectively than their tunnel-exited counterparts. Of the diverging series, a .6 cm throat worked the best.

#Alternate to LIYSF - United States Navy/Naval Air Systems Command

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HOT BATTERY VS. FROZEN BATTERY

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The purpose of this experiment was to find out if the temperature of the battery had any effect on the performance of the battery. This includes the voltage output and overall efficiency of the battery. One battery was heated to the temperature of boiling water. The other was cooled to the temperature of frozen water. The batteries were then wired to a load and the voltage output measured.

I found that the heated battery had a larger voltage output than a frozen battery. Then, after a measured amount of time, the voltage was again measured. The heated battery lost the lesser amount of vpltage and the forzen battery lost the greater amount of voltage.

The conclusion is that the heated battery has a greater voltage output and is more efficient.

There could be possible applications for the manufactures of commercial batteries. More extensive research could show that the storage temperature of batteries could significantly effect their performance.

# ALCOHOL-WATER TURBULENCE

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The turbulent mixing encountered when alcohol comes into contact with a water surface was investigated. The hypothesis tested was that this phenomenon is caused by suface tension forces of the interacting water and alcohol. Several types of experiments were performed, using different methods of bringing the alcohol in contact with the water. Many of these involved qualitative observations of the character and properties of the effect. The most important quantitative data were taken using a very sensitive shadowgraph apparatus to view the interaction. Using this apparatus, a new detail of the effect was rendered visible: a flow pattern resembling an array of petals radiating from a central drop area. This was seen for certain concentrations of alcohol in the drop and in the pool to which it was added. The threshold for the turbulent effect was measured in terms of the alcohol concentration in the drop for several alcohol concentrations in the pool to which it was added. According to these data, the effect depends on a difference in surface tensions between that of the drop and that of the pool. This difference must be above the threshold difference of 4 to 9 dynes/cm for the turbulent phenomenon to be seen. Based on this and various qualitative data, it was concluded that the effect is caused by the imbalance between the surface tensions of water and alcohol.

#London International Youth Science Fortnight - United States Marine Corps

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USING PHYSICS TO EVALUATE CAR WAXES

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The purpose of this research project was to determine the relative properties (shine, smoothness, resistance to weathering, ease of application and economy) of seven leading automobile waxes using the principles of physics and scientific evaluation. Types of products tested included softened paste wax, liquid wax, polymer sealants, spray wax and aerosol wax. The materials were applied according to the manufacturers' directions to sections of a plastic coated test panel, with one section left untreated as a control. Measurements were taken in each section for (1) friction, using a weighted slip plate connected to a spring scale and (2) reflected shine measured on a photographic light meter from a standard light source at a regulated distance from the test section. The test panel was then exposed face upward to direct winter sunlight and weathered for a one month period; washed; and wiped dry with clean buffing cloths. The friction and shine tests were repeated to determine the effects of the weathering. Each wax was applied to a car, and the experimenter subjectively judged the ease of application. Coatings were applied to marked off sections of a cut down car hood so that the seven formulations and the unwaxed sections could be visually compared. Results show real differences between waxes with varying degrees of improved smoothness, shine and protection against weathering.

AERODYNAMICS: What is Lift and Drag?

Stephen Norris
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Aerodynamics is a science that deals with the motion of air and the effect it has on an object.

My project deals basically with the lift and drag created by an airstream on an airplane wing. An apparatus was constructed to show the lift and drag produced on different shaped airfoils. This enables you to see that the shape of an airfoil affects its ability to accomplish the lift necessary for flight while not creating an excessive amount of drag.

The fan produces the airstream needed and the honeycomb grill straightens the airflow. By placing a protractor behind the wing, I established the angle of attack. An airstream was applied to the wing and the drag was registered on the cardboard gram indicator at the bottom of the pendulum. The lift was determined by adding weights to the right pan on the scales until balance was achieved. The angle of attack was adjusted to different degrees and the lift and drag was recorded for each angle of attack.

The results were recorded on graphs and the characteristic curves were drawn from these results.

After the experiments, I felt that it was obvious that while the shape is important, the angle of attack is equally important in producing the desired lift needed to create flight.

THE EFFECTS OF NOZZLE DESIGN ON ROCKET MOTOR PERFORMANCE

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This experiment was to determine if, as research indicates, the rocket nozzle with a 15 degree expansion chamber is actually the most efficient design for a small rocket motor. The author constructed a number of standard motors with expansion chambers of 0,15,30, and 45 degrees. The motors tested were constructed using constant weights of materials and the same batch of fuel, and were tested within a short period of time, minimizing variations other than nozzle design. The rockets were tested on a dynomometer constructed by the author, and recorded the thrust generated by the motor over time. Each nozzle design was repeatedly tested and an average of the two best firings from each design was used to calculate the results. The results showed that the best nozzle design had an expansion nozzle angle of 30 degrees, although research materials indicate that large rocket motors and engines perform most efficiently with 15 degree nozzle chambers. The author theorizes that this is due to the fact that, while large rocket motors burn most of their fuel in a combustion chamber which is vented to the nozzle chamber, the small motors used in this experiment developed a percentage of their thrust by burning fuel in the nozzle chamber, creating a fluid nozzle which focused the escaping gases. This demonstrates that various designs may require different nozzle chamber angles in order to develop maximum efficiency.

#VISUAL REVERSALS OF PHOTOGRAPHIC NEGATIVES

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The basis of this project is an analysis of two somewhat obscure optical effects observable when black and white photographic film is viewed from the same side as the light source. The first is a scattering effect which results in the production of a positive image, and the second is a much more complicated reflectance effect which produces a negative image.

Objective testing was carried out to determine quantitatively the effects of density development and the angle of incident light on the images. Qualitative analysis was done using spectrally pure coloured filters. Electron micrographs were also made as an aid to understanding the importance of internal film structure in the production of the reflectance negative.

The first reversal effect was also observed in X-ray and colour slide film.

#First Award - Society of Photographic Scientists and Engineers
Alternate to Scholarship - University of Alabama in Huntsville
Fourth Award - General Motors ISEF
Honorable Mention - Optical Society of America

FAILURE OF FLUID FILLED BEAMS

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The strength of an empty tube differs from the strength of a tube filled with a fluid. This project deals with the differences in strength of hollow tubes when filled with various fluids. By building an apparatus on which I could accurately measure the force and displacement required to break sealed tubes filled with different fluids, I was able to measure the force which a tube could withstand before failure. Observations were also made concerning the behavior of fluids under stress in this type of system.

I found that properties of fluids such as density and viscosity would have great effects on the load capacity of a sealed tube filled with these fluids. Fluids with high viscosity and low density allowed the tube to carry a larger load than an empty tube. The main objective of the project was to see if these specially filled tubes would follow Hooke's Law for bending and breaking, and to see if a Hooke's constant could be established for various fluids. If the fluid-filled tubes deviated from Hooke's Law, I wanted to find out which factors or properties of the fluid would cause this deviation.

I found through experimentation that Hooke's Law did in fact apply to the behavior of these tubes. I was also able to conclude that very dense liquids seemed to increase elasticity of the tubes, and make them stronger also. Very viscous fluids raised the carrying capacity of tubes while decreasing elasticity, since they were less easily bent.

#REAL TIME TRANSMISSION HOLOGRAPHIC INTERFEROMETRY: DETERMINATION OF MINUTE REFRACTION INDEX CHANGES TO FACILITATE WATER FLOW VISUALIZATION FOR FLUID/AERODYNAMIC APPLICATIONS

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The purpose of this research was to design, construct, modify, and apply a real time transmission holographic interferometry system and environment capable of measuring minute changes in refraction indexes to facilitate the visualization of water flow past a test specimen thus showing the water's relationship to the object.

Real time transmission holographic interferometry was used to detect displacement of six millionths of an inch as well as changes in refraction index of laser light. This was achieved by overlapping the original test medium with a holographic recording of that same test medium. Any changes in the original test medium from the holographic recording results in fringe formation, i.e., butane gas to air, warm water to cold water, and warm air to cold air.

Research for experiments was conducted in the basement of the researcher. Most devices were built from scrap materials with cost in mind. The water channel pump was found in an old washing machine; a vibration isolated table was built for under $200 as compared to commercial VIT's costing several thousand dollars; an anti-vibration shutter system was built from a block of wood and three strings.

Over forty individual devices were designed or constructed as were a myriad of optical set-ups. Each device and set-up was tested through trial-and-error to determine the best alternative until a successful combination was created.

The researcher was capable of visualizing the flow of water past a test specimen with the use of real time transmission holographic interferometry. This new technique may act as an alternative to standard water channels and wind tunnels for military, medical, chemical, and engineering applications.

#First Award - Ball Electronic Systems Division and Ball Aerospace Systems Division
First Award - General Motors Corporation
First Award - Optical Society of America
Second Award - General Motors ISEF
Third Award - Bureau of Reclamation/United States Department of the Interior
Third Award - Society of Photographic Scientists and Engineers

#ALGEBRAIC CONSTRUCTION OF ONE-DIMENSIONAL QUASI-CRYSTALS

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A new class of crystals, called quasi-crystals, was discovered only a year ago. Quasi-crystals have more than one unit cell of atoms which are repeated at irregular intervals.

I investigated the algebraic properties of one-dimensional quasi-crystals with two unit cells to derive an algebraic formula for the positions of the atoms.

I derived the relationship between one-dimensional quasi-crystals and sequences of ones and zeros introduced by de Bruijn. Properties of these sequences were used to derive explicit expressions for the positions of the quasi-crystal atoms and for nearest neighbor distances. In addition, I derived a solution to the "hopping problem" when unit cells switch positions, and a classification of one-dimensional quasi-crystals in which all identical but shifted quasi-crystals are classified into a single class.

#First Award - General Motors ISEF

#THE EFFICACY OF SEEDANTS IN A MAGNETOHYDRODYNAMIC GENERATOR

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In a magnetohydrodynamic (MHD) generator, a high temperature plasma is fired through a duct (x-axis) with conducting walls (electrodes) on the y-axis (above and below) and an applied magnetic field along the z-axis. The voltage, produced across the opposing electrodes, depends on the velocity and flow of the plasma, the strength of the magnetic field, the geometry of the duct, and the conductivity of the injected seedant in the plasma. To produce maximum efficacy the factors that influence the system must be optimized. In this project, all factors are kept constant except for the conductivity of the plasma, which is altered by the injection of different nitrate salts (seedants) into the working fluid at the same molar concentration. To date, nitrate salts of several different metals have been tested in an MHD generator that I designed and built. The metals from the first and third groups proved to be the most efficacious. The order of effectiveness was: cesium, rubidium, potassium, sodium, lithium, indium, aluminum, gallium, cerium, copper, barium, magnesium, calcium, and strontium. The conductivity correlated with the ionization energies of the elements as determined by Pearson Product-Moment statistical analysis. The null hypothesis was rejected at the P less than .001 level. No correlation was observed for the ionization energy of the electron following the valence electrons, mass, resistivity of 1M solutions and free metals, and atomic radius. The strong correlation with first ionization energy indicates that metals with low ionization energies are the most promising seedants.

#First Award - Allegheny International
First Award - National Aeronautics and Space Administration
First Award - United States Army
First Award - United States Department of Energy
Third Award - American Association of Physics Teachers

CAN LIGHT EXTINCTION DETERMINE SOLUTION CONCENTRATIONS

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As light passes through a translucent medium it changes; absorption refraction, and scattering occur due to the physical properties of the solutions. The gradual diminishing of light as it passes through this medium can be called extinction. The purpose of this project is to determine if light extinction through a solution can be used to determine the concentration of the solute to the solvent.

The method should be able to determine the approximate salt to water concentration of most saline solutions. When the extinction curve through saline solutions has been determined, any saline solution can be compared to curve.

The extinction curve through saline solution was determined by using two aquariums, a collimated beam of light, and light meter. The light extinction rate through various saline solution was compared to the extinction curve.

The approximate concentration of solute to solvent of saline solutions can be determined through the use of light extinction.

#AN ELECTRONICALLY STIMULATED SYNTHETIC MUSCLE SYSTEM,

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Research was conducted to design a synthetic muscle that, upon electronic stimulation, contracts 15% of its total length with a net force proportional to $1N/cm^2$ simulating the force and contraction output of a human muscle.

Piezoelectric materials develop a potential difference across their surface when exposed to a dimunitive amount of pressure. Furthermore, the reversal of this process produces a stress or strain along its length, width, and height. In other words, Piezoelectric materials can be stimulated electronically producing an electro-mechanical reaction of extension and contraction.

Of all known materials, a ferroelectric polymer, polyvinylidene flouride (PVDF) exhibits the greatest piezoelectric activity. Up to 95% of the molecular units take part in the piezoelectric reaction. The maximum contraction, however, along one axis is approximately 0.015 mm. Fortunately, a multimorph, analogous to a bimetallic strip can be fabricated to produce a bending motion with a substantial force. Moreover, a chain of multimorph laminates linked with reversed polarity generates a sinusodial contraction with a directional force output.

When designing the Synthetic Muscle System, several factors were considered such as length, width, bond layer thickness, applied voltage, and number of layers. The dimensions of a multimorph that outputs the previously stated specifications was computed on a computer and then constructed.

#First Award - United States Navy/Office of Naval Research
Second Award - Sigma Xi, the Scientific Research Society
Second Award - United States Air Force
Alternate to Scholarship - United States Navy/Office of Naval Research
Third Award - General Motors ISEF

THE STUDY OF PARAMETERS THAT AFFECT CIRCULAR MOTION

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By using a large wooden disk rotating on a turntable at a constant frequency, the radius at which various masses resting on the disk overcome friction,or, in other words, slipped was determined. The radius at which a constant mass overcomes friction at various frequencies was also determined. The relationship between these variables (mass, frequency, and radius) was ascdrtained by plotting the recorded data on a graph. The manner in which the variables were plotted was altered (e.g. squared, inverted, square-root) until the plotted points became a line. Thus, the relationship between the variables was determined. The wooden disk was inclined until the maximum angle the rotational surface could make with the horizontal was reached with the mass on the surface remaining at rest. The tangent of this angle was taken to determine the coefficient of static friction of the surface of the disk. It is the friction of this surface which the mass must overcome in order to slide off the disk.

AN EXPERIMENTAL ATTEMPT TO DETECT THE SUPERPHOTOELECTRIC EFFECT

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The normal photoelectric effect produces the emission of an electron from the surface of a metal when photons of light of sufficient energy are incident on the metal surface. Light below the cutoff frequency is not normally expected to produce photoelectrons regardless of the intensity of the light.

However, quantum theory predicts that if the incident light is intense enough there is the possibility of two photons being absorbed simultaneously, i.e. within the Heisenberg Uncertainty lifetime. In this manner it is possible that even light below the cutoff frequency could eject detectable photoelectrons. This phenomenon has been here dubbed the SUPERPHOTOELECTRIC EFFECT. To search for this effect, light of wavelength 633 nm from a helium-neon laser was tightly focussed on a photocell equipped with a stopping voltage to measure the kinetic energy of ejected electrons. No such current was found on even the most sensitive scale of a picoammeter.

# BRAGG DIFFRACTION: ACOUSTIC IMAGING OF OPTICALLY OPAQUE MATERIALS

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PURPOSE: use longitudinal compression waves from an ultrasound transducer and an optically modified laser beam to interact in a water-filled acoustic cell with the object to be imaged to produce a visible image of optically opaque materials of sufficiently favorable resolution and detail to detect structure.

PROCEDURE: the object to be imaged was placed in a water-filled acoustic cell in the path of a generator driven ultrasonic quartz transducer. Ultrasonic acoustic waves passed through the object to be imaged and produced wavefronts perpendicular to the laser produced light beam. The laser beam was modified by a spatial filter, circular plano-convex lens, vertically oriented cylindrical plano-convex lens and a double convex lens. The acoustic waves broke the light beam symmetrically into a diffracted beam, and a residual beam which passed straight through the water. The residual beam was modified by a double concave lens and only the down-shifted image was allowed to pass through the horizontally oriented cylindrical plano-convex lens and the resultant wedge-shaped image was detected by a vidicon camera and projected onto a television monitor.

CONCLUSION: the Bragg Diffraction system of acoustical imaging does produce an image of optically opaque materials detectable by the vidicon camera and projectable onto a television monitor. Structure was not discernable by my system.

#Second Award - Optical Society of America
Third Award - General Motors ISEF
Honorable Mention - Acoustical Society of America

TESTING THE AMOUNT OF DISPLACEMENT ON A DIFFUSE SURFACE USING HOLOGRAPHIC INTERFEROMETRY

Thomaskutty, Champ, Brewer H. S., Somerville, AL 35670
Rt. 3 Box 202, Somerville, AL 35670

Measurement of the displacement of a metallic beam fixed at one end by holographic interferometry is the purpose of this project.

A single exposure hologram of the metallic beam is taken in a regular holographic setup. Then a displacement of 0.0002 inches is applied at one end of the beam and a second exposure is taken. This is called double exposure holographic technique. The exposed plate is then developed. Then, during reconstruction, the two holograms (reconstructed by the first and second exposure) interfere with each other, and an interference fringe pattern is formed. The number of fringes are counted for the theoretical analysis of the displacement measurement.

A number of straight line fringes are formed on the beam, with close fringes near the loading point. The displacement is calculated theoretically. Then, the experimental and the theoretical values are compared and plotted. The two values match very closely.

Holographic interferometry has wide spread applications in the measurement of surface displacement. Holographic nondestructive testing of space vehicles is just one of many examples.

A double exposure holographic interferometry technique was used to measure the displacement of a metallic beam fixed at one end. The theoretical and experimental results coincide very well within the limits of experimental error.

#UNDERWATER GLIDING

Schroeder, Paul, Rockledge H.S., Rockledge, FL 32955;
642 Orange Ct., Rockledge, FL 32955.

With this project "Underwater Gliding", I intend to prove that gliding underwater provides an energy-efficient, storm-free method of carrying cargo. The same forces that operate on an airborne glider are present underwater. The only major difference between gliding in the air and gliding underwater is density. Therefore, an underwater glider performs in a similar manner to an aerial glider in almost every respect. Exception: The distinct advantage which ensures the practicability of an underwater glider is the upward glide. That is, when you reach the bottom of your downward glide you would "blow the tanks" as in a submarine and glide upwards. Because of the use of natural forces, gravity (down) and buoyancy (up), the only fuel energy expended is that required to compress the necessary amount of air. This varies according to initial tank size, rate and depth at which tank decompression occurs. In the past I glided down with an 8:1 glide ratio. This year I experimented with the amount, positioning, and method of introducing the buoyancy and was able to achieve an 8:1 upward glide, completing the cycle of (a) downward glide, (b) transition (blowing the tanks) and (c) the upward glide. This cycle would be repeated in a full-size glider in order to cross vast distances using miniscule amounts of energy.

#Alternate - United States Department of Energy
Third Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

LIFETIME EXTENSION OF THE R-LINE FLUORESCENCE IN RUBY

Jung, Jackson H., Alhambra H.S., Alhambra, CA 91803;
2322 Roscommon Ave., Monterey Park, CA 91754.

In this research, the extension of the lifetime of excited Cr^{3+} ions in ruby was attempted in light of theory supporting that such lifetime extension should lead to a decrease in required pump energy for three-level solids. In returning to the ground state, excited ruby atoms emit radiation known as R-Line fluorescence. The lifetime of the exponential decay of this fluorescence was studied. Research was conducted based on the hypothesis that the lifetime of the fluorescence could be increased by surrounding the laser material with white, diffusely reflective $BaSO_4$ powder to trap emitted radiation within the ruby and minimize the loss of energy. A 9 mm diameter by 106 mm length ruby rod was used for experimentation. The rod was pumped by a krypton ion laser, and fluorescence studies were made both with the rod in $BaSO_4$ and in a control black environment using a photomultiplier tube. The results from placing the ruby in $BaSO_4$ show a marked increase in fluorescence lifetime. A maximum 38% increase was observed. Similar work with other three-level solids must still be done, and the exact decrease in required pump energy which this lifetime extension should lead to still must be determined. It is hoped that a more efficient three-level solid-state laser system can result from this work.

#Scholarship - University of Alabama in Huntsville
Fourth Award - General Motors ISEF

THE EFFECTS OF FILTERED LIGHT ON HOLOGRAPHY, Douglas L. Edson

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This project was devised to see how monochromatic light, being flooded into a darkroom, affects three-dimensional photography (holography).

An Apple IIe computer was used to turn "on" and "off" the laser via a relay and hex-inverting chip for an accurate laser light exposure. Filtered lights of monochromatic red and green were used to flood the room, one at a time, when taking the holograms. The film used was sensitive to only one wavelength of light (in this case, monochromatic red).

"Transmission" holography was the type done, which means the object can be reconstructed using a laser at a precise angle. To make this type of hologram, you must: split the coherent laser beam into two beams; expand the beams with a diverging lens; direct one beam on the light sensitive film; direct the other beam on the object causing light to reflect off the object onto the film, resulting in an interference pattern; and develop the film in the same room with holographic developer.

"White" blotches were observed when using the green filter. No interference pattern was seen when using the red filter.

The white blotches were caused by imperfect filters which allowed small amounts of red light through. As the filtered light's wavelength approached 6328A, monochromatic red, the hologram becomes less and less defined. Therefore, if the filtered light being flooded into the room is other than monochromatic red, holograms can be made.

THE VERTICAL MOTION OF AIR BUBBLES IN WATER

Wluka, Gerald M., Melbourne Church of England Grammar School,
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27 Hampden Road, Armadale, Victoria, 3143, Australia.

The aim of this investigation was to deduce the equation of motion for air bubbles in water. This would appear to be a relatively simple task, but in fact, was rather complex. A method for measuring the velocity of bubbles had to be developed. The experimental results were analyzed intensively.

The velocity of bubbles of known volume (2-5cc) was recorded at set depths (20-90cm). From this data, it was possible to calculate an equation of motion, and thence deduce a number of relationships between the volume, velocity, depth, acceleration and time of travel of the bubbles.

Since simple statistical analysis of the experimental results did not yield a clear-cut conclusion, theoretical values were calculated from first principles. The model relied on the experimental results to establish an essential constant. Once this constant was known, the other relationships could be calculated. The model predicted all of the experimental results. Its applicability to other situations is the subject of further research.

#SOUND RECORDINGS OF HUMMINGBIRD FLIGHT

Carr, David L., Los Altos High School, Los Altos, CA 94022;
24285 Summerhill Avenue, Los Altos, CA 94022.

This project explores the use of soundwaves to study the hovering flight of hummingbirds. Existing methods of study have been limited to visual techniques and address only a narrow range of aspects of flight. With the present technique, the sounds produced by the bird's wings are used to explore many facets of flight. This study both confirms findings from book research and provides new insight on flight dynamics.

The sounds of flight are recorded on cassette tape through a microphone while the hummingbird feeds, and analyzed with oscilloscope and oscillograph. When displayed, the sound yields a regular pattern, a sound-wave representation of the movement of the bird's wings.

I explored three events in the hovering. First, I measured the wavelength of the basic cycle to find beat frequency and continuity. Second, by noting changes in the shape of the cycle, I determined when the bird changed wingbeat pattern from hover to level flight. Third, I found that to change position while hovering, the bird uses bursts of accelerative and decelerative power, rather than 'flying' from one position to the other. This part of my study I consider the most significant, as only conjectures of dynamics are offered in my references.

Further research could correlate each part of the sound cycle with the corresponding part of the wing cycle, using information on aerodynamic sound production and high-speed movies of the wing movement. My hope in further study is to determine whether the bird uses 'dynamic stall', knowlege useful to aircraft and helicopter research.

#Third Award - General Motors ISEF

SALT GRADIENT SOLAR PONDS PHASE III: AN ENERGY AND EFFICIENCY ANALYSIS OF THE SEVIER DRY LAKE AS A POSSIBLE SALT GRADIENT SOLAR POND.

Amundson, Per K., Bonneville High School, Ogden, UT 84403;
1000 East 6550 South, Ogden, UT 84405.

This research study represents the third phase of a 3 year project involving the enhancement of efficiency and the analysis of a prototype Salt Gradient Solar Pond(SGSP) and power plant. The purpose of the third phase of this research has been to mathematically analyze the feasibility of a 1km^2 SGSP sited at the Sevier Dry Lake area using research findings from phase one and two. The Sevier Dry Lake area is located in S.W. Utah. This site was selected for consideration because of its geographic and geologic properties including solar insolation. Procedures: Solar insolation, both direct beam and diffuse radiation, was calculated from NOAA weather data which represented part of a 46 year data base. Surface reflection and refraction were calculated with Snell's Law and Fresnel's Equation. Direct beam and diffuse radiation exhibit different conductive, reflective and absorptive properties and were therefore calculated separately. Radiation absorption in the Lower Convective Zone was approximated by Hull's method using experimental data. Convective, conductive and evaporative losses were experimentally determined and taken into account. Heat lost to the ground was calculated using S.B. Savages's equation. A Carnot efficiency of approximately 7% was assumed for a Rankine cycle heat exchanger. Conclusion: Utilizing experimental data and the equations referred to above, it was found that a 1km^2 SGSP sited at the Sevier Dry Lake would be capable of producing approximately 2 MW. Assuming a current power cost of $.085 per Kwhr, the pond would have an amorization rate of 10-14 years. This study indicates that a SGSP at the Sevier Dry Lake site would be theoretically feasible as a future alternative source of energy.

#OBTAINING KINETIC ENERGY THROUGH HEAT

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This project involves the theory that the temperature of a body is equivalent to the average kinetic energy of its constituent particles (molecules), and that a change in the temperature of this body will result in a change in this energy. An experiment was conducted using elastic (rubber) bands and a heat source which supported the hypothesis of the theory of kinetic energy.

The experiment was conducted by stretching opposing elastic bands between two points with equal and opposite force. When stretched, the elastic bands represent potential energy. As one side of these elastic bands was heated, they began to contract, pulling (stretching) the opposite elastic band a corresponding amount, further increasing their potential energy. The potential energy of the elastic bands changed to kinetic energy as long as the bands were in motion. After several experiments demonstrating this effect the experimentor developed a kinetic machine using a bicycle wheel. This consisted of removing existing hardware (rigid wire spokes), and replacing them with elastic bands symmetrically placed throughout the entire circumference of the wheel. This resulted in an equal and opposite potential energy between the outer rim and center hub of the wheel. By applying heat to one side of the wheel the forces of kinetic energy are released and the wheel will revolve about its axis.

This experiment was conclusive in demonstrating how potential energy (energy of position) can be affected by heat and light sources to become kinetic energy (energy of work or motion).

#First Award - General Motors ISEF

THE EFFECT ON THE SPACIAL POSITIONING OF DAPHNIA IN RELATION TO MAGNETIC AND ELECTRIC FIELDS

Pluym, Tammy C., St. Clair H.S., St. Clair, MN 56080
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I wanted to find out if the spacial positioning of Daphnia was affected or changed when they were subjected to a magnetic or electrical field passing through their environment.

Five transparent tubes with ten Daphnia in them were placed in a room with constant lighting and temperature. An electromagnet and a permanent magnet were placed under two of the tubes, having the strongest magnetic field going straight through the center. Two other tubes had an AC electrical field passing through the center, and the other had a DC electrical field passing through the center. The fifth tube had no field passing through it and was the control. Strengths of the fields were increased every two days; the experiment was run for 14 days. Pictures were taken every day to record the spacial positioning of the Daphnia within the tube.

The Daphnia in the experiment clearly avoided the magnetic and electrical fields. They avoided the center of the tube where the strongest field was, and as the strengths were increased, the Daphnia moved farther towards the ends of the tubes. At the strengths used, the electrical fields had a larger affect on the Daphnia than the magnetic fields did. The AC and DC fields affected the Daphnia equally as well. The control tube had an even distribution of Daphnia in the tube during the entire experiment.

In this experiment, the spacial positioning of Daphnia was affected as they attempted to avoid the magnetic and electrical fields when compared to a control.

IDENTIFY AIR POLLUTION BY SPECTRAL ANALYSIS OF AIR POLLUTANTS

Joe Chang, Clearfield High School, Clearfield, Utah 84015
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The purpose of this project was to identify air pollutants by photometric analysis of different gases in the atmosphere. The basic concept used was quantum mechanics, with which I used the specific spectral lines to identify various gases.

The approach to this project was to build a home made spectrophotometer, and then to apply photography to do photometric analysis of known gases. Using these results as a basis for further research, I expanded this project by taking absorption spectrums on the photometric analysis of our environment, and compared the known gases obtained from previous research with the unknown results from our atmosphere. This approach made it possible to identify air pollutants.

The second part of this project was on the quantitative analysis of air pollutants. By comparing all the photographs on a percentage scale, I was able to accomplish both quantitative and qualitative analysis.

The overall project was very successful. I found out a new possibility for identifying air pollution and a more practical use of spectrophotometric analysis.

HOW DOES MICROWAVE FREQUENCY 2.45 GHz ELEVATE FOOD TEMPERATURES?
Boone, Jeanette, Modesto High School, Modesto, California 95351
2324 Woodland Avenue, Modesto, California 95351

PURPOSE: To determine whether food is heated from the inside out or from the outside in when it is cooked by electromagnetic energy in a microwave oven.

PROCEDURE: Interior temperatures of foods were checked at three locations within the food -- at regular intervals during the cooking process. A graph was prepared for each food to show the heat penetration pattern. Graphs were analyzed and compared.

RESULTS: Temperature recorded at the center of each food was always lower than at 1½ centimeters from the outside surface. Temperature at 3 centimeters from the outside surface was somewhere between the other two. Heat penetration patterns fell into several categories, apparently relating to food density.

CONCLUSIONS: Microwaved foods were heated from the outside in. This was not accomplished by the application of heat to their external surfaces, but rather by friction of the molecules within the food itself. Friction was created by electromagnetic vibrations of moisture in the food at the rate of 2.45 billion times per second. The intensity of these vibrations was greatest near the exterior surfaces of the food.

REFLECTIONS: An awareness of how microwave frequency 2.45 GHz elevates food temperatures can greatly increase a microwave cook's success in her food preparation.

ZOOLOGY

TOXICITY OF CITRUS PEEL LIQUIDS AND FUMES TO THE RED IMPORTED FIRE ANT AND THE COCKROACH. Karen M. Green. West Thibodaux Jr. High School., Thibodaux, LA 70301. 414 Wisteria Street, Thibodaux, LA. 70301

Reports of orange peels being toxic to bugs were recently published. Experiments to determine the toxic effects, if any, of orange peels on fire ants were conducted. The peels of oranges were subjected to several different physical and chemical methods of extraction. Results indicated that orange peels do produce a substance toxic to fire ants. This material can be extracted using selected solvents. Tests also showed that the substance readily evaporates and it is the fumes that are toxic. Insecticidal activity of citrus oil was shown through direct application and fumigation. Pest control activity was shown against the Red Imported Fire Ant (*Solenopsis invicta*), the cockroach (*Periplaneta* sp.) and the common dog flea. Tests conducted showed that citrus oil was more effective in killing the fire ant and the cockroach under test conditions than certain commonly used insecticides and herbicides.

THE EFFECTS OF ACIDIFICATION ON AMPHIBIAN EMBRYOGENESIS
Chick, Dawn M., Roncalli H.S., Manitowoc, WI 54220;
249 Homewood Drive, Brillion, WI 54110.

No exhibit.

#THE TAXONOMY OF MACROLEPIDOPTERA

Haile, David L., Holy Name High School, 955 E. Wyomissing Blvd.
Reading, PA 19611;
612 Museum Road, Reading, PA 19611.

Purpose: The purpose of this project is to determine if reliable congruence between Macrolepidoptera phylogenetic classification and wing scale structure can be numerically established. If so, then taxonomic models can be formulated which will simplify current classification methodology.

Procedure: Using specimens obtained from various geographic locations, microphotographs of wing scales scraped from the discal region of the forewing were taken. Structural measurements were recorded and the taxonomic significance of each measurement was statistically evaluated.

Results: Basic structural characteristics of Macrolepidoptera wing scales, when used collectively in a statistical format, differentiate the specimens by subfamily. Taxonomic model parameters were created for each subfamily studied.

Conclusion: Wing scales can be numerically proven to constitute a morphologic character which adheres to traditional classification categories. Those few scales which deviate significantly from model parameters indicate the need for further taxonomic evaluation of the specimen.

Application: The formulation of objective taxonomic models will speed the identification of specimens in both field and laboratory situations, enhancing and/or replacing time-consuming wing venation techniques presently used in systematic work of the Order.

#First Award - Eastman Kodak Company
First Award - Entomological Society of America
First Award - General Motors ISEF
Operation Cherry Blossom Trip Award - United States Army

# DRUGS WEAVE PATTERNS

Fay, Doug S., Grapevine High School, Grapevine, TX 76051
2905 Hickory Hill, Colleyville, TX 76034

The purpose of this experiment was to show the effects of caffeine, alcohol and nicotine on the geometric pattern of a spider's web. Orb-weavers produced webs daily and consumed them at night. Dilute solutions of the above mentioned chemicals were misted (individually) on normal webs. Photographs were taken on the following day after new webs were produced. Comparisons were made between normal/caffeine-influenced webs, normal/alcohol-influenced webs, normal/nicotine-influenced webs.

Webs were traced from photographs, digitized by computer graphics, and acetate over-lays made for comparisons.

All drug-influenced webs deviated drastically from the normal webs with individual characteristics. Variations of geometric patterns clearly indicated that these drugs affected the ability of the spider to weave its web. Application of these results could be made to all living systems including human behavior.

#Honorable Mention - Eastman Kodak Company

#THE EFFECTS OF CALCIUM CHANNEL BLOCKERS IN DAPHNIA

Jacobson, Jessica L., Miramonte H.S., Orinda, CA 94563;
53 East Altarinda Drive, Orinda, CA 94563

Calcium is an important regulator of electrical mechanical activity in all muscle cells. The calcium channels, which are also known as slow channels, in cardiac muscle cells are critical for normal cardiac rhythmicity. The effects on cardiac rate caused by calcium and verapamil, which is a calcium channel blocker, has been studied in daphnia. These effects have not previously been studied in inverterbrates. Daphnia magna was selected because of its transparency allowing direct counting and observation of the cardiac rate. Individual daphnia were placed on microscope slides in a single drop of aged spring water, and the heart rate was counted at a 25X magnification over a 30 to 60 minute period. A dose dependent effect of verapamil and calcium on the cardiac rate of daphnia has been shown. Verapamil caused a bradycardia while calcium caused a tachycardia. Calcium when added to the daphnia prior to the verapamil prevented the bradycardia. Calcium when added after the verapamil reversed the bradycardia. The reversibility through the addition of calcium indicated that the decreased cardiac rate caused by the verapamil was not a toxic depression. The verapamil dose in daphnia exceeded the human dose on a gram per gram basis. However, the diffusion of verapamil through the general body surface may be limited. This experiment indicated that the calcium channel is similar over a wide array of organisms.

#First Award - American Veterinary Medical Association
Third Award - General Motors ISEF

INDUCING GENETIC MUTATIONS IN DROSOPHILA MELANOGASTER THROUGH THE USE OF ASPARTAME: TESTING THE SAFENESS OF NUTRA-SWEET

Dill, Juston, Highland High School, Ewing, MO 63440
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The safeness of artificial sweetners has caused controversy for quite some time. Recently a sweetner by the brand name of Nutra-Sweet has been raising some new questions about the testing of new food products. The purpose of this project was to study and determine if aspartame, the chemical name for Nutra-Sweet, would cause genetic mutations in Drosophila melanogaster and if so to hypothesize its effects on human chromosomes.

Two cultures of Drosophila melanogaster were obtained and after raising a considerable number of flies in each, these were separated and introduced in to separate cultures as follows: group A: 4.4g medium, 4g aspartame; group B: 4.4g medium, 2g aspartame; group C: 4.4g medium, 1g aspartame; control: 4.4g medium, 0g aspartame. The medium for each group was mixed with 15g of distilled water. The figures for amount of medium and amount of water were arrived at through the use of a standard measuring device for the instant Drosophila medium used (Formula 4-24 from Carolina Biological Supply).

Prior to the start of research a hypothesis was made based on research into the testing of aspartame, stating that the aspartame/medium solution would cause a considerable amount of mutation in the flies raised from larva in it. This hypothesis proved true in research. This research could be expanded further by testing the effects of large amounts of aspartame on the chromosomes of mammals.

STUDY RECOGNIZING GENETIC INDIVIDUALITIES IN RATTUS NORVEGICUS USING OLFACTORY SENSES

Bilbao, Angelee M., Elko High School, Elko, Nevada 89801;
931 Hillside Drive, Elko, Nevada 89801

Four rats, 2 males 2 females, all from different families were chosen and paired. Couple #1 had 9 offspring, couple #2 had 7. Urise samples were collected from all 4 adult rats. The offspring were then tested with the samples of urine in a Y-maze situation at 2½weeks of age and then again at 8 weeks of age as follows 1) Mother's urine on one side, the other side empty. 2) Mother's urine on one side and #2 males on the other. 3) Mother's urine on one side and #2 female's on the other.

At 2½ weeks of age all offspring went to the mother's urine in over 75% of the trials in all three situations. At 8 weeks of age the females went to the male #2 urine (rather than the mother's) at a ratio of 4 to 1 and the males went to the female's (mother's)urine sample at a ratio of 3 to 1.

CONCLUSION: I was correct in my hypothesis in that young rats (pre-pubescent) are able to seek out the known scent of their mother using only olfactory sensing of urine samples in a Y-maze situation. However, I had not considered that sexually mature rats (puberty is 7-8 weeks) are more attracted to the scent of the opposite sex more strongly than that of their mother.

This project topic was chosen because of an interest in animal behavior and a hope to go into a feild of medical study.

THE CHRYSOTHAMNUS GALL SYSTEM

HEPPLER, HEATHER LYNN., Dixie High School, St. George, Utah 84770;
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Previous research had established three different gall forms on the Chrysothamnus plants in my study areas. A white furry gall which I called "woolly". A greenish gall called "spiny"; and a small brown gall called "cone". A tephritid fly was found to be the cause of the "woolly" gall. A cynipid wasp was found to cause the "spiny" gall. This year it was established that a cynipid also caused the "cone" gall form.

Using an isolation chamber of my own design, portions of the stems of Chrysothamnus were treated with larval and pupal extracts in an effort to produce galls on the plant without the actual presence of the insect. Sterile water injections were used as a control. The galls were photographed as they formed and compared with normal gall growth. Injection frequency for proper gall maintenance was also studied. It was found that injections three times per week would maintain gall integrity. It was noted that larval injections were better for growth than pupal injections but pupal injections seemed to maintain the integrity of the gall better than larval injections. It is apparent that the insect must be present to maintain proper gall formation.

A new parasite was found this year that had not been previously found on the rabbit brush gall system. I believe it to be a diptera or a coleoptera but as yet the adult form has not appeared. It has not been found during the previous three years of this study. I plan to continue the study one more year and then have my work published.

THE DEVELOPMENT OF TRIPLOID GOLDFISH AS A MEANS OF IMPROVING GREATER FOOD EFFICIENCY IN COMMERCIAL FISH PRODUCTION

Hinton, Ronald L., Highland High School, Ewing, MO 63440
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Since fish farming has become such a growing industry in recent years, there has been an increased interest in improving efficiency of growth to food ratios. One method that has proven successful is to induce sterility in young fish which allows the use of food energy to be concentrated on growth instead of sexual maturation. Several methods ranging from the use of chemicals such as steroids to various physical treatments have been tested.

This project is designed to induce triploid fry in goldfish using heat or cold shock treatment twenty minutes after fertilization of the eggs occurs. This genetic condition causes natural sterility and has favorable side effects. Measurement of young fish was made when they were five weeks old to determine growth differences. Statistical analysis of length was conducted to determine whether there is significant growth difference. Flow cytometry will also be used if cooperative sources can be obtained to verify the production of the triploid condition.

CARBON DIOXIDE: NECESSARY FOR CORAL GROWTH

Chang, Daniel S., Samoana H.S., Utulei, 96799
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An experiment was conducted involving the establishment of two aquaria with and without fish repectively. Observations were made and data were collected over a period of fourteen (14) days. Having analysed the data, it seems that a certain amount of carbon dioxide is necessary for the survival and growth of coral.

#EFFECTS OF "JUMPING GENES" AND DIFFERENT TEMPERATURES ON THE FERTILITY OF THE DROSOPHILA MELANOGASTER FIRST GENERATION MALE

Tsekerides, Ted E., Sleepy Hollow H.S., N. Tarrytown, NY 10591
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Crosses between M strain females and males from P strains which harbor jumping genes usually produce high sterility and other aberrant traits in the F1 generation. These aberrant traits, which also include high mutation rates, are referred to as Hybrid Dysgenesis. According to previous studies, many factors influence the degree to which these traits appear. One critical factor which contributes to hybrid sterility is temperature. Male sterility is characterized by the absence of larvae after the male is allowed to mate for a period of four days. From each F1 dysgenic male, three 4-day broods of sperm were tested for fertility; the brooding therefore measured the effect of male aging on spermatogenesis. However, from males that were determined to be fertile, some showed a lower rate of fertility than others.

#Fourth Award - General Motors ISEF

Geomys pinetis: GOPHERS vs. BUILDERS

Scott L. Morris
Kathleen Sr. High
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Geomys pinetis is commonly known as the southeastern pocket gopher. Found in the sand hill communities of central Florida, Geomys prefers a well-drained sandy loam. However, rural land developers prefer the same specific land conditions. The sand-hill communities' availability and easy access makes them easy prey for sub-urban sprawl. The outstanding problem ,mounted on the loss of habitat, is the competative exclusion between the gophers and the homeowners. Many homeowners take great measures to rid themselves of the"pest".

In normal situations nature would run its course and the gophers would slowly migrate out. However, the moist environs of a surrounding stream prevent this from occuring.

This study,now in the third year, was conducted to gather ecological dataon this species in hopes of its application to a relocation program carried out with state.

This year's data centralized on the Geomys' burrow fauna and behavior. Other areas studied were burrow gases and caloric values of food staples.

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THE GROUPING HABITS OF MOSQUITO FISH

Rachel Kelley, Leon High School, Tallahassee, Florida 32301;
3400 Monitor Lane, Tallahassee, Florida 32312.

Gambusia affinis, mosquito fish, are very common in sluggish ponds and streams, marshy pools, and sometimes brackish water in the South. Any information about these fish would be beneficial to people involved in mosquito control because these fish feed on mosquito larvae and are introduced into streams and ponds to reduce the mosquito population. It is evident from studies of fish that schooling behavior varies with the species. The conclusions drawn from experimentation of the schooling behavior of mosquito fish could be expanded and combined with results from similar experiments of other fish. The results would aid individuals involved in mosquito control and fishermen who use these fish as bait or who catch fish that follow the schools for food.

The aim of this experiment is to determine if Gambusia affinis prefer to school with their own or similar species, in large or small groups, and in groups of what gender and age ratio. I believe that because these minnows populate waters that can hold similar fish, they will not prefer their own species over another. Also, because one male often mates with several females, they may prefer more females than males in their group. I will present the methods used and results obtained from my studies and experiments on Gambusia affinis, mosquito fish.

#IMPRINTING OF ALTRICIAL BIRDS

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Imprinting of altricial birds is a new area of research in bird behavior. Precocial birds have been extensively studied while altricial birds have been relatively ignored. Imprinting type behavioral side effects have been observed in many endangered species of altricial birds raised in captivity. This project explains why these side effects unexpectedly appear. Imprinting of precocial birds is well documented as unable to occur beyond 36 hours after hatching. Due to the above mentioned imprinting side effects, I hypothesized that altricial birds must imprint beyond 36 hours after hatching. Only one imprinting characteristic (following imprinted object) has been established for precocial birds. This is insufficient for altricial birds due to their helplessness at hatching. Five new, observable imprinting characteristics for altricial birds were established for this project. As 36 hours is the maximum imprinting time for precocial birds, baby ringneck doves (Streptopelia risoria) were taken from the nest at random time intervals (42 hours-11 days) after hatching. They were handraised and observed for appearance of the established imprinting characteristics. All subjects displayed all five characteristics. The appearance of these characteristics and time of appearance were recorded. This project establishes that altricial and precocial birds differ significantly in both their imprinting characteristics and critical imprinting times. Additional research in altricial bird imprinting may aid in reducing the imprinting side effects in endangered species raised in captivity. This may result in greater success in returning these endangered species to the wild.

#Second Award - United States Air Force

#THE EFFECTS OF VARIED STRENGTHS OF ELECTROMAGNETIC FIELDS ON THE CRYPTOBIODIC LIFE STAGE AND SUBSEQUENT GROWTH OF ARTEMIA

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THE PURPOSE OF THIS PROJECT WAS TO SEE IF AN ELECTROMAGNETIC FIELD HAD AN EFFECT ON ARTEMIA IN THEIR CRYPTOBIODIC LIFE STAGE, AND SUBSEQUENT GROWTH, DEVELOPMENT AND MORTALITY RATES. THIS RESEARCHER PLACED 20 ARTEMIA EGGS IN VARIED STRENGTHS OF ELECTROMAGNETIC FIELDS. ONE PETRI DISH WAS KEPT AWAY FROM THE ELECTROMAGNETIC FIELDS AS A CONTROL. THREE PETRI DISHES WERE PLACED IN ELECTROMAGNETIC FIELDS OF VARIED STRENGTHS. ALL OTHER CONDITIONS REMAINED THE SAME. DATA WAS TAKEN ON 3 TRIALS AND THE FOURTH WAS PHOTOGRAPHED. THE DEVELOPMENT AND GROWTH OF THE EXPERIMENTAL AND CONTROL GROUPS WERE CLOSELY OBSERVED.

THE RESULTS WERE AS FOLLOWS. THE ARTEMIA IN THE STRONGEST FIELD HAD THE LOWEST HATCH RATE AND THE HIGHEST MORTALITY RATE. AS THE FIELD STRENGTHS DECREASED, SO DID THE MORTALITY RATE, AS DID THE SIGNS OF STRESS.

THIS RESEARCHER CONCLUDED THAT THE ADVERSE DEVELOPMENT AND MORTALITY RATE ON ARTEMIA IN THEIR CRYPTOBIODIC LIFE STATE AND SUBSEQUENT GROWTH, WAS DIRECTLY RELATED TO THE ELECTROMAGNETIC FIELDS IN RELATION TO FIELD STRENGTH.

#Third Award - General Motors ISEF

HEREDITARY CHARACTERISTICS OF *DROSOPHILA* AND THE EFFECTS OF RADIATION

Donaldson, Kendall E., Glen Burnie H. S., Glen Burnie, MD 21061;
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Through this project, I had hoped to determine the comparative ratios of selected characteristics inherited over three generations of *Drosophila melanogaster*. I also wanted to determine the effect that factors such as species, sex, radiation and any other factors which become apparent during experimentation may have upon these ratios.

To solve my problem, I obtained four species of fruit flies which I cross-bred to the third generation. I also bred pure strain wild flies which were radiated at my dentist's office to the second generation to determine any mutations. I used these statistics to determine the ratios at which specific characteristics were inherited and what mutations were present over generations.

My experimental ratios were relatively accurate compared to the theoretical ratios which were expected. Through the analysis of my results, I was able to make several conclusions. The apterous condition is a recessive trait to the dominant winged characteristic. Eye color is a sex-linked trait. Radiation causes mutations in the flies, but through two generations these mutations decrease. The characteristics of the parents are reflected in their offspring. This process of heredity is similar to that which occurs in human beings. I intend to expand on the subject of radiation during the coming year.

This project enables me to improve my basic skills such as organization, concentration, and reasoning. This should be of benefit to me now and in the future.

REPRODUCTIVE BIOLOGY OF THE FRESHWATER SHRIMP *MICRATYA POEYI* (GUERIN-MENEVILLE) (DECAPODA, ATYIDAE): EMBRYO PRODUCTION AND SIZE RELATIONSHIP BETWEEN ADULT MALES AND GRAVID FEMALES

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Micratya poeyi (Guérin-Méneville) is a small freshwater atyid shrimp found in the West Indies. It is a shrimp about 2.54 cm. which has been found in areas of swift-flowing currents over rocky ground and in among the roots of vegetation found along the shore line of rivers. In this study we decided to determine the correlation between the number of embryos found in pregnant females and the size of this species females. At the same time we tried to determine another correlation between the size of the adult male of said species. We selected 50 pregnant females and 50 males. For each the number of embryos found in the abdominal cavity were counted. Then the length of the females carapace was measured and these data were compared as well as the males carapace length. These results were compared to the length of the females carapace. To do all these tests and measures we used the facilities of the University of Puerto Rico's Biology Museum. From the statistical analysis of the data it was found that the larger the size of female, the greater the quantity of embryos produced. It was also found that the females carapace size is larger than that of the male of the species. We expect to do the same study with other species of the same family.

#NOTES ON THE BIOLOGY OF AMEIVA EXSUL (COPE) IN SOUTHWESTERN PUERTO RICO

Irizarry, Luis A., Félix Arce Lugo C.E.T., San Germán, PR 00753;
Box 47, San Germán, PR 00753.

The lizard Ameiva exsul Cope, the common "iguana or siguana" of the Caribbean is one of the most abundant and less known literally of the reptilian fauna of Puerto Rico. This investigation is an attempt to improve our knowledge on mainly two aspects of the biology of this lizard, its food habits and the parasites that attack this form on the island.

Eighteen stations were chosen for this study. Environmental parameters were determined for the habitat where the lizards live. A total of 215 lizards were collected and examined for external as well as internal parasites. The incidence of infection was one of 40.4%. A total of 1,177 parasites were found. Of the parasites 7% were mites, 27% were cestodes, 24% were nematodes, 30% were trematodes, .001% were pentastomides and 12% were acanthocephalans. Three species of nematodes were found, Species A had 4%, Species B had 13% and Species C had 13%.

The diet of A. exsul was found to consist of crickets, ants, roaches, worms and other insects. A good determination was not possible since many of the organisms obtained from the field had bread in their stomach.

#Honorable Mention - Eastman Kodak Company

#CONTROL OF SOLENOPSIS INVICTA WITH A LIME OIL TOXIC BAIT SYSTEM

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The purpose of this project is to determine the most effective formulation of attractant, toxicant and carrier in a lime oil toxic bait system; establish potential for use of this system in control of the imported fire ant; and identify specific components that contribute to the effectiveness of the system.

Lime oil toxicant was determined to formulate best with an egg yolk attractant. Various solution ratios of lime oil/egg yolk were tested for attracting ability and toxic effect. 1:2 and 1:5 lime oil/egg yolk solutions showed toxic bait potential due to the best combination of attraction and delayed toxicity.

Egg yolk attractant was mixed with corn grits and colored with a dye. This mixture was put into a case connected to a container of ants. Numerous granules were seen in the nest after a 7 day period indicating the suitability of corn grits as a carrier.

1:2 and 1:5 lime oil/egg yolk solutions with carrier were put in two cases connected to an ant colony. Both toxic bait systems were effective in attracting and killing ants. The 1:5 solution showed best potential for colony eradication due to the large number of granules transported to the nest.

Lime oil was fractionally distilled resulting in components of citronellol, H_2O and fruit sugar. 1:2 & 1:5 mixtures of citronellol and egg yolk were tested for toxic effect and attracting ability. This component was found to be more toxic than lime oil alone but overrode all of the ability of the attractant. The delayed toxic effect of the 1:5 lime oil/egg yolk solution and its attracting ability make this mixture the best choice for use in a toxic bait system.

#Second Award - General Motors ISEF

#CONTROL OF PARASITES THROUGH ENZYMATIC DEGRADATION OF THE EXOCUTICLE

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Horsemen spend millions annually on the control of bots and other internal parasites, but current chemicals are only effective on the inside of the horse; once damage has already taken place. Why not break the bot cycle before it starts, while the bots are still on the forelegs of the horse? This is the problem on which my project is based.

I gathered several hundred bot eggs from various horses and applied a 10% "chitinase" solution to the eggs. Within 12 hours, the chitinous rings in the exocuticle were completely decomposed, and thus the larvae were prematurely exposed to the atmosphere and died. I conducted viability tests and found that every egg that had been treated with "chitinase" was inviable.

In further testing, I tried to determine if "chitinase" would be harmful to the horse or to the environment. I applied 30%, 60%, & 90% solutions of "chitinase" to both light and dark pigmented horse hair. After letting the hair soak for 72 hours, I conducted a microscopic inspection and found that the hair had not changed in any way.

I also conducted tests on the skin of the horse by spraying a 30% solution of "chitinase" on an area of exposed skin. No change in color, irritation, or inhibition of hair growth was recorded. The chitinase shouldn't have any adverse effects on the environment or other mammals because it is found naturally in the moulting fluid of insects.

If chitinase could be marketed commercially, it could possibly be used on other parasites such as crickets and beetles, stress on the horse would be reduced, and worming costs would be significantly less.

#First Award - United States Army
Third Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

#The Effects of Copper on Aquatic Organisms

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In the two last decades, we experienced a substantial decline in the natural fish and shellfish populations in Florida. This unexplained decline coincides with the growth of population in Florida and with its subsequent manifold discharge of wastewater and extensive use of copper in water treatment.

Generally, the toxic effects of copper on aquatic organisms have been known for quite some time. The Environmental Protection Agency set standards for allowable levels of copper in discharged wastewater believed to be adequate for the survival of most organisms in the affected aquatic environment.

This writer did, however, discover a specific effect of cupric ions on the early developmental stages of many fish larvae. The larvae of many fish species have special glands located at the head which secrete a mucous filament after the larvae hatch. The larvae attach themselves with this adhesive filament to firm substrates, or even to the surface of the water, in order to keep from falling into mud, and thus suffocating. Concentrations of copper that are much lower than the EPA standards inhibit the functions of these glands. As a result, the larvae are not able to attach themselves in strata with a sufficient level of oxygen, descend to the bottom of the body of water, and subsequently die due to suffocation.

#First Award - General Motors ISEF

A STUDY OF THE POSSIBLE USE OF THE TROPICAL PLANT *MELIA AZEDARACH* L. FOR THE EXTERMINATION OF *AEDES AEGYPTI* AND OTHER HARMFUL INSECTS.

Vázquez, Reinaldo M., Julio V. Guzmán J.H.S., San Germán, P.R. 00753;
Box 627, San Germán, P.R. 00753.

The tropical plant *Melia azedarach* L. known for its narcotic, poisonous and insecticidal properties was used in the erradication of a series of insects, harmful to agriculture and to man.

The investigation was done in different phases. On the first and second phase, larvas of Aedes aegypti, were treated with different concentrations of extracts from leaves, the most effective part of the plant.

On the third phase, extracts from leaves, fruits, seeds and stem were used in the erradication of insects, all harmful to plants used by man for food. Water and methanol were used as solvent. Extracts were tested on the following insects: *Spartoceras batatas*, *Solenopsis germinata*, *Nasutitermes costalis*, *Periplaneta americana*, *Umbonia crassicornia*, *Tribolium confusum* and *Petrusa marginata*. Fruit water extracts were more effective in the elimination of *Solenopsis germinata*. Leaves water extracts were more effective in the erradication of *Tribolium confusum* and *Nasutitermes costalis*. Fruit and leaf water extracts acted with about the same strength with *Petrusa marginata*. The stem water extracts did not show effectiveness in any of the tests. Fruit methanol extracts were effective against *Tribolium confusum*, *Petrusa marginata* and *Nasutitermes costalis*. The stem methanol extract was the least effective and the leaf extracts had medium strength.

Thin layer chromatography showed leaf extracts to separate into six spots. Biological action was found restricted to Spots 5 and 6 which may be the same. Separation of fruit extracts using the same method showed two spots. Biological activity was restricted to Spot 1.

ECOLOGICAL AND COMPARATIVE STUDY OF THE EFFECTS OF NATURAL AND ARTIFICIAL FOOD COLORANTS IN THE DEVELOPMENT, GROWTH AND BEHAVIOR OF GUINEA PIGS.

Vale, Carlos A., Dr. Efraín Sánchez Hidalgo H.S., Moca, P.R. 00716;
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In this invetigation we carried out a study of the effect of artificial and natural coloring in the development, growth and behavior of guinea pigs.

Daily portions of food were administered with annatto and seasoning (Accent Seasoning) considering the temperature, environment and quantity of water and foo consumed. On a weekly basis, they were weighed in grams, measured in centimeters and their behavior was observed.

The investigation was done with 24 guinea pigs or eight pairs given annatto, seasoning and control ones.

The following results were obtained. Guinea pigs with natural annatto showed better growth and weight than those that were given seasoning. These had a gradual development and growth but to a lesser degree than the control and annatto ones.

In the second part of the investigation, which lasted 5 weeks, we studied the reproduction and progeny of the guinea pigs. As a results, the guinea pigs that consumed annatto had a progeny just as the control ones. Where as the ones that consumed seasoning indicated a sign of possible sterilization, having no progeny when mating.

THE EFFECTS OF ROENTGEN RAYS ON PUPAE OF *MUSCA DOMESTICA* VS OFFSPRING OF RADIATED PARENTS

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What could occur in an unborn child when a mother is exposed with a chest roentgen ray? Due to the intensity of the radiation, could abnormalities occur in the changing cell structure? The pupal stage of metamorphosis in *Musca domestica* is much like that of an unborn child for they both are going through drastic physical changes. My project was irradiating *Musca domestica* in the pupal form to find what effects would be produced, then comparing the irradiated pupal offspring of irradiated parents.

In this experiment, I tried to determine: (a) would radiation induce mutations? (b) by increasing the radiation, would mutation rate also increase? (c) could the hatch rate of pupa be affected, and (d) how would pupal forms outcome compare to the offsprings results?

The two groups were irradiated together at different intensities and time intervals, using a medical x-ray. The offspring laid eggs, the eggs hatched and went through the stages of metamorphosis into adult flies. Pupae hatched and were noted. The groups were placed under a stereoscope and abnormalities and normalities were recorded.

I found that by irradiating pupae of houseflies, mutation did occur as much as 96% in comparison to a 33% mutation in the control group. When the number of kilivolt peak and amount of exposure time were increased, the percentage of mutation also increased from a low of 76% to a high of 96%. The hatch rate in pupal form was not effected by exposure to radiation. My comparison of the two groups showed an average of 14% more mutation in the pupal stage than in the offspring of irradiated parent flies. Therefore, I conclude that roentgen rays are more dangerous to pupae than the offspring of irradiated parents.

THE MUTAGENIC EFFECTS OF MICROWAVE RADIATION ON *DROSOPHILA MELANOGASTER*

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The mutagenic effects of microwave radiation on *Drosophila melanogaster*, the common fruit fly, were studied. In 1983 research was conducted dealing with the effects of microwaves on genetic inheritance in *Drosophila melanogaster*. Results conclude that microwave radiation does cause genetic damage to *Drosophila* and this damage is passed on to future generations. In 1984 research was conducted dealing with the effects of microwaves on the salivary gland chromosomes of *Drosophila melanogaster*. Results conclude that microwave radiation does have an effect on the overall structure of the salivary gland chromosomes. In 1985 research was conducted dealing with a possible "fragile-site" on the salivary gland chromosomes that is susceptible to genetic damage through microwave exposure. No definite conclusion can be drawn yet because this research is still being studied.

Through all of this research one basic question has arisen: Are the induced mutations an effect of the radiation or the heat of microwave exposure? This year research was conducted to answer this question. Adult fruit flies were divided into two groups. Group 1 was exposed to microwave radition, while Group 2 was exposed to heat. The mutation rate in the offspring of each group was determined and compared. The data was studied through statistical analysis. Results conclude that radiation is the major cause of the induced mutations.

Research dealing with a possible microwave-induced "fragile-site" on the chromosomes is continuing. Also, research dealing with microwave-induced lethal mutations is being conducted.

#THE EFFECT OF THE ELIMINATION OF MUTUALISTIC BACTERIA IN THE MANDUCA SEXTA

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The purpose of this study is to determine the effects of partial gut sterilization on the growth rate of Manduca sexta.

Mutualism, the relationship between two different species in which both species are benefited, is very common between insects and bacteria that are living in their digestive tract.

Bacteria were isolated from the midgut of the Manduca sexta. These bacteria were then subjected to sensitivity tests to various antibiotics. The antibiotics that were effective on the isolates were incorporated into Manduca sexta media for the purpose of gut sterilization. Antibiotics that were not effective on the isolates were also incorporated into media for the purpose of a control.

Also for the purpose of gut sterilization, Manduca sexta eggs were sterilized, placed in sterile vials, and fed sterile media, making for a sterile environment. For the purpose of control, unsterile eggs were placed in unsterile vials and fed autoclaved, but air contaminated media, to see if autoclaved media would support normal growth.

Results from this study indicate that when bacteria in the Manduca sexta are eliminated by use of antibiotics, or by propagation in a sterile environment, the growth rate of Manduca sexta is limited and the pupation is delayed.

#Third Award - General Motors ISEF

NOTES ON THE BIOLOGY OF NEPHILA CLAVIPES IN SOUTHWESTERN P.R.: WEB CONSTRUCTION AND ELASTICITY

Nazario, Ketty A., Blanca Malaret H.S., Sabana Grande, PR 00747;
P.O. Box 236, Sabana Grande, PR 00747.

Nephila clavipes belongs to the orb-weaving spiders; of the silk spiders groups, distinguished by the strength of their spiderwebs. Due to this characteristic, we are going to determine a construction pattern, and the strength and elasticity of the Nephila clavipes spiderwebs thread. During the first phase of this investigation, twenty-five spiderwebs were collected and were divided in a coordinated axle. Each angle per quadrant was measured. According to these measurements, four types of construction patterns, per quadrant, were established. The elasticity tests were carried out during the second phase. We determined the average cross-sectioned area and the average diameter of one hundred samples of threads. Different weights were applied to fifty different threads, the thread elongation (caused by the application of weight), were marked on graph paper, located on the wood instrument used. At the end, we had a free body diagram, that helped us to determine the tension on each side of the thread due to the application of weight. Using some formulas, according to material mechanics, we were able to determine the average stress and average strain of the thread. This data, helped us to obtain how the average area and average diameter were affected. We could see that the cross-sectioned area and the diameter of the thread schrink after the application of weight. According to these formulas, the thread has a little range of elasticity, but has a plastic deformation, and it is similar to the ones found in some engineering materials.

#PLEIOTROPIC EFFECTS OF DILUTE, A NEW SPONTANEOUS MUTATION IN THE SYRIAN HAMSTER, MESOCRICETUS AURATUS

Levin, Stephen I., Glenwood High School, Chatham, IL 62629;
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The purpose of this project is to determine the extent of the pleiotropy of the gene dilute.

My hypotheses are that the gene dilute is affecting the onset of reproduction in dilute animals and that the gene dilute affects the weight at weaning in animals from dilute parents.

To test these hypotheses, four types of crosses were completed: wild type by wild type, dilute by dilute, dilute males by wild type females, and wild type males by dilute females. Data for onset of reproduction were collected by using the following formula: date of birth of the female's litter - the date of birth of the male or female parent - 16 days (gestation period). This formula provides the number of days from birth to the female's first estrus cycle or for the male, the number of days from birth to insemination of the female. The weaning weight data was collected by weighing the animals 21-25 days after birth.

A t-Test was used to compare data from wild type by wild type crosses to data from dilute by dilute crosses for both onset of reproduction and weight at weaning. The onset of reproduction data produced a t-value of 6.0764 with 44 degrees of freedom ($P=10^{-6}$). The weaning weight data produced a t-value of 2.452 with 116 degrees freedom ($P=0.0156$).

The statistical analyses of these data strongly support the hypotheses that the gene dilute is affecting the onset of reproduction and weight at weaning.

#Fourth Award - General Motors ISEF

#A STUDY ON THE WASP -The Mecanism of Determination of the Sexual Function in Vespula lawisii-

Soya, Akira, Inakita H.S 2165 Ina, Nagano 396;
Minamiminowa, Kamiina, Nagano 399-45

The wasp is one of the most common insects found in the hills and fields. The queen which has wintered builds a nest in the ground, increases the workers and expands the nest in spring. In fall, she oviposits the new queen. On a calm fine day in late fall, the new queen and the drones leave the nest to copulate and pass winter.

I have been studying morphology, ecology, and physiology of the wasp for eight years. I have especially been interested in why workers can't oviposit, though both the queen and the workers are females.

The main differences between the queen and the workers on the mophological points of the reproductive organ are as follow:

(1)The overy of the queen grows well, but the workers' do not grow well.

(2)The follicular cells in the egg chamber of the queen are observed as growing powerfully, but the workers' do not grow as powerfully as those of the queen.

(3)In the queen's ovarioles are the malurated oocytes with yolk granules, but in the workers' one cannot see the oocyte.

I found that these differences depend on the amount of hormonal secreation from corpora allata. By experiments involving the decapitaion and legation of the head, breast and the chest, I have found that he amount of hormonal secreation play the leading role in determining the sexual function of the queen and the workers.

#Second Award - General Motors ISEF

INVESTIGATING THE PROS AND CONS--PERCA P. FLAVESCENS VS. CAMBARUS C. VIRILIS--A STUDY OF THE INTAKE OF RADIOACTIVE PHOSPHORUS

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The purpose of my project was to compare the radiation intake of the fish as compared to the crawfish. I used 1 control and 5 experimental models of each species. After placing the experimental models in P32 they were sacrificed with ethyl ether and dissected. I took 3 tests on the following organs of each species and averaged the amount of radiation in each organ. The following were the results:

	FISH	CRAWFISH
Heart	9.57 c/m	409 c/m
Gills	7.46 c/m	1178 c/m
Meat	2.37 c/m	42 c/m
Intestines	9.04 c/m	3511 c/m
Stomach	7.43 c/m	435 c/m
Liver	3.80 c/m	304 c/m

Because of the anatomical differences between the fish and crawfish, the meat absorbed the least radiation. Therefore, I can conclude that to consume the meat is not harmful, because the slight radiation detected in the meat is not high enough to be of much or any danger to the consumer. Over 90 pounds of meat would have to be consumed to be slightly affected.

#DISCOVERY OF AN OVAPREDATOR AND A PARASITOID IN THE EGG CASES OF LATERODECTUS MACTANS

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750 North 2850 East, St. Geroge, UT 84770

An unique chain of ecological relationships has recently been discovered in Southern Utah. For the first time *Pseudogaurax signatus* and Eulophidae have been identified in the egg cases of the Black Widow.

Pseudogaurax signatus is a predatory fly, in larvae form, on *Laterodectus mactan's* eggs. Eulophidae is a parasitoid wasp upon *Pseudogaurax signatus*.

They form an ecologically-balanced natural control limiting the population of *Laterodectus mactans*.

#Fourth Award - General Motors ISEF

THE NEOBLASTS ROLE IN PLANARIAN REGENERATION

Andonov, Walter B., Valley H.S., Las Vegas, NV 89121;
3929 Cedaredge Court, Las Vegas, NV 89120.

No exhibit.

STUDY OF SOME BIOPHYSICAL ASPECTS RELATED TO THE BEHAVIOR OF THE ANT-LION *MYRMELEON INSERTUS* HAGEN

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Myrmeleon insertus Hagen is a member of the family Myrmeleonidae which is commonly known as an ant-lion. This name came from the fact that the larvae of the best known species, the pitfalls diggers, feed mainly on ants.

Up to now some studies have been carried out in the ecology and development of this animal, but enough emphasis has not been directed to the physical aspects. The purpose of this investigation is to determine the size of the cones in different soils. An attempt is also made to determine the trayectory of the soil particle; to determine the velocity of the animal in a given distance and the determination on the relationship between the weight of the pebble and the weight of the ant-lion.

The ant-lion builds traps in a conic form. After analizing this structure in the natural soil this showed an area of 13.5 cm^2 and a volume of 3.22 cm^3. It was found that the type of soil exerts an effect on the construction of the pit. Results revealed that a specific size will minimize it.

During the phase of the analysis of the physical aspects involved in the description of the path, a series of statistical tests were carried out in relation of the pitch of the pebble. The horizontal range, height, flight path and the time of fall of the pebble were determined for three types of pebbles and for each type of soil used in the construction of the trap.

# BIOLOGICAL ASPECTS OF THE COCKROACH *ASPIDUCHUS CAVERNICOLA* (REHN, 1951) (ORTHOPTERA: BLATTIDAE) FROM SOUTHWESTERN PUERTO RICO

Cardona, Nedgar, Lola R. De Tió H.S., San Germán, PR 00753;
18 Javilla Street, San Germán, PR 00753.

Investigation attempts to increase our knowledge of the cockroach *Aspiduchus cavernicola* (Rhen, 1951), an endemic cave dweller from southwestern Puerto Rico. Nothing is known of the biology of this very interesting genus. This species is found in Cueva de Monte Grande in Cabo Rojo, Puerto Rico living sympatrically with the cosmopolitan species *Periplaneta americana* (L.). A comparison of both species has helped us to improve the knowledge on this species.

Study involves description of cave, environmental parameters in a 24 hours period, taxonomy, polutation, competition, food items, chemistry, physiology, behavior and particularly internal parasites. External and internal anatomy has been studied. Measurements of length and width of body, three legs, antennae and wings were taken and standard deviations determined for each measurement, for males and females. Phallus, ootheca, digestive tube and enzymes have been studied. Phallus indicates it is a primitive roach. *Aspiduchus* is ovoviviparous and bigger than *Periplaneta*.

Chemical analysis was carried out to determine water, organic matter and mineral content. Protein concentration and amino acids were compared. Oxygen consumption, oviposition, righting response, ranges of antennae movement, velocity, soil preference, surface they climb and grooming behavior have been studied. Fifty roaches were examined for parasites and over 600 nematodes were found in the hindgut. Parasites are in process of being identified. Life cycle of *A. cavernicola* is being determined.

#Third Award - General Motors ISEF

A BIOLOGICAL STUDY OF *ORTHOCRICUS ARBOREUS* (SAUSSURE, 1859) (DIPLOPODA:SPIROBOLIDA)

Torres, Yadira, Lola Rodríguez de Tió H.S., San Germán, PR 00753;
Carr 348 km 15.4 Rosario Alto, San Germán, PR 00753.

Orthocricus arboreus (Saussure, 1859) is a small to large millipede characterized by the shape of the male gonopods which is common throughout the Caribbean. In Puerto Rico it is quite common in the southwestern part of the island. Very little is known of the biology of this millipede besides the fact that it has several subspecies. This investigation represents the beginning of a designed to improve our knowledge of this species.

Millipedes studied in this work all come from 2 stations, Cain Bajo and Caín Alto in San Germán. Environmental parameters in which they are found include a relative humidity around 50-60%, a light intensity of 380-400 foot candles, a substrate temperature of 78°F, an air temperature of 28°C and a wind velocity of 9mph.

Measurements of length and width were determined. Lenght was 84.64mm ± 8.11mm. Width was 6.04mm ± 0.93mm. Number of legs and segments were recorded as well as their weight. The average number of legs was 202 legs, that of segments 52. Average weight was 2 grams.

Several aspects of the biology of this species have been studied. Velocity was .011148 m/sec. ± 5.91 m/sec. Geotaxic response was 2.12cm ± 17.90cm. Height preference range 1.37-3.48m. They prefer darkness. Sixty percent of them showed a straight line movement pattern before centrifugation and 76% an irregular movement pattern after centrifugation. An average of 5% in relative humidity was prefered by this millipede.

A 100% of them survived exposures of 2 hours underwater; 33% survived 4 hours. All are gone after 6 hours.

Parasitological studies revealed the presence of mites on the surface. Nematodes and gregarines are found on the hindgut. Incidence of infection iquals 100%. Fourteen species of nematodes and two species of gregarines have been found. A possible hyperparasite may have been found on the body of one of the nematodes found.

EXAMINING THE EFFECTS OF VARIOUS CONCENTRATIONS OF TRIETHYLAMINE AND ETHER, AS ANESTHESIA, UPON *DROSOPHILA MELANOGASTER*

Curnutt, Cris, Cooper High School, Abilene, Texas 79605
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The purpose of my experiment is to determine how varying the concentrations of anesthesia would affect the mortality rates of *Drosophila melanogaster*.

Using apterous cultures of the flies, I diluted two commonly used anesthesia, triethylamine and ether, with water to known concentrations. These concentrations were used to anesthetize the fruit flies and determine the time required for the insects to become unconcious. Further, the rate of survival of the flies following the anesthetization were noted and recorded.

Following five trials using fresh fruit fly cultures, I found that a dilution of 1:4 of ether was most effective in putting the flies to sleep and had the greatest survival rate. A dilution of 1:3 of the triethylamine was most effective using the same criteria.

In conclusion, the variance of anesthesia concentrations would prove more effective in the survival rates of *Drosophila melanogaster* when used in genetic experimentation.

# A FIVE YEAR INVESTIGATION INTO THE CONTROL OF CTENOPHALIDES FELIS

Blake, Julia, J., Suwannee High School, Live Oak, FL. 32060
312 Gay Street, Live Oak, FL., 32060

The purpose of my project is to find the most effective way to kill the common cat flea, Ctenocephalides Felis, which is the flea that is most often found in Florida on house pets.

My hypothesis is that some products on the market are better than others in controlling the common cat flea, and my experiments will determine which are best.

Materials used were commercial flea powders and sprays, insecticides used by qualified pest control operators, tobacco dust, talcum, diatomaceous earth, fleas, eggs, cocoons, carpet, sand, blood meal, tubes,etc.

Over a period of years, I did experiments using sprays, powders, insecticides, and insect growth regulators. I set up controls to see how many fleas would die without exposure to the products. I compared results. I developed and tested a home-made flea powder. I repeated an experiment using cotton to make the environment more like cat fur.

I found sprays kill more fleas than powders and that home-made powder works better than commercial products and costs less. In the experiments with insecticides on carpet, any of the three will effectively kill live fleas, but Dursban or Ficam Plus are more effective on both live fleas and cocoons. In the experiments using insect growth regulators, I found that Safrotin was most effective overall in controlling both eggs and larvae; however, Methoprene was slightly more effective on larvae but was poor on eggs. Safrotin controlled the hatching of eggs slightly better than Dimilin. To prove the accuracy of the results, I did a computer statistical analysis program on the insect growth regulator experiments.

#Fourth Award - General Motors ISEF

EFFECTS OF ASPARTAME ON THE HELIOTROPIC RESPONSE OF DROSOPHILIA MELANOGASTER

Burney, Richard O., Auburn H.S., Auburn,AL 36830
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The purpose of this project was to observe any effects of aspartame on the nervous system of Drosophilia through an experiment involving the insect's heliotropic response - the natural attraction to light.

In this experiment, ten Drosophilia (fruit flies) were placed in each of two petri dishes. The variable dish contained an agar medium consisting of a 1 gm Nutrasweet /50 ml H_2O concentration, whereas the control dish consisted of a standard agar medium. All other potential variables were held constant. After a 72 hour time period to allow the flies in the variable dish to ingest the chemical aspartame, the heliotropic response of the flies was tested. Each dish was placed in an enclosure that permitted light to shine on the dish. A cover was placed over exactly half of the dish. After all the flies had moved to the illuminated side, the cover was moved to the opposite half of the dish and timing commenced. The time required for all ten flies to move to the illuminated side of the medium was recorded.

Upon analysis of the two hundred times recorded in the study, the flies administered aspartame proved to be significantly slower in their heliotropic response — more than 40% slower. The results indicate that an abnormal dose of aspartame (500 mg/kg body weight) does affect the heliotropic response of Drosophilia. It may therefore be concluded that such a dosage of aspartame is effective in inhibiting the proper nerve functioning of Drosophilia melanogaster.

# TRAIL PHEROMONES OF FIRE ANTS: A GAS CHROMATOGRAPHIC STUDY

Ellgaard, Annemarie K., Grace King H.S., Metairie, LA 70002;
6512 Wilty St., Metairie, LA 70003

Red imported fire ants Solenopsis invicta follow artificial trails made with several solvent extracts of homogenized ants; such as diethyl ether, ethanol, water, petroleum ether, or pentane. The solubility characteristics indicate that the trail molecules in these extracts are a mixture of compounds including long-chain hydrocarbons. Of several long-chain hydrocarbons tested, pentadecane was shown to cause trail following.

All solvent extract trails persisted for at least 4 hours suggesting that there are trail molecules less volatile than the highly volatile trail pheromone, discovered in this species by Wilson (1962), which dissipates in 20 minutes. Observations on natural trails supported this interpretation. Food foraging trails persisted for only 30 minutes while nest relocation trails remained effective for 7 hours. Gas chromatographic studies done on natural trails show that nest trails contain three compounds of about thirty carbon length not found in food foraging trails. These long-chain hydrocarbons could account for the increased longevity of nest relocation trails.

This is the first time it has been reported that different trail types have different longevities. I suggest that ants specify their two types of trails by varying the relative concentrations of the short-chain (highly volatile) and long-chain (less volatile) hydrocarbons they secrete. However, since I also observed that the longevity of pentane extract trails increased with the concentration of extract used, the lifetime of a trail might additionally be regulated by the quantity of pheromone laid down.

#Fourth Award - General Motors ISEF

THE EFFECT OF INDOMETHACIN ON SELECTED BEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF ETHANOL IN WISTAR RATS: TWO NEW PROCEDURAL CONSIDERATIONS.

Pearcy, Clifford A., Monte Vista H.S., Monte Vista, Co. 81144
515 1st. Avenue, Monte Vista, Co. 81144

PURPOSE: The purpose of this research was to examine two new procedural considerations in research involving prostaglandin inhibitors and some of the selected behavioral and physiological effects of ethanol and also the effects of a prostaglandin inhibitor (indomethacin) on selected behavioral and physiological effects of ethanol in Wistar rats. PROCEDURE: 1. 10 male Wistar rats were injected initially with a .015 ml/g dose of .9% saline followed 2 hrs. later by a 3.5 g/kg, 25% w/v dose of ethanol. Two weeks later the same animals were injected with .015 ml/g dose of .9% saline followed 2½ hrs. by a 3.5 g/kg, 25% w/v dose of ethanol. 2. 10 more Wistar rats were injected initially with a .015 ml/g dose of .9% saline followed 2½ hrs. later by a 3.0 g/kg, 25% w/v dose of ethanol. Two weeks later the same animals were injected with a 1.25 mg/kg dose of indomethacin followed 2½ hrs. later by a 3.0 g/kg, 25% w/v dose of ethanol. 3. 10 more rats were initially injected with a .015 ml/g dose of .9% saline followed 2½ hrs. later by a 3.0 g/kg, 25% w/v dose of ethanol. With each experiment sham controls were run and sleeptime, temperature, horizontal bar and blood tests were run. CONCLUSION: The volume of injection affects some of the effects of ethanol with different intervals between injections. There also exists possible over and under estimations of the effects of indomethacin on acute ethanol exposure. Because of these findings, the effects of indomethacin on acute ethanol exposure in Wistar rats can't be determined at the present.

#THE EFFECT OF VITAMIN B_6 ON *DROSOPHILA* POLYTENE CHROMOSOMES

Brady, Sean F., Clinton Central H.S., Clinton, NY 13323;
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Drosophila hydei salivary glands have "giant chromosomes" with characteristic bands by which individual chromosomes and regions on the chromosome may be identified. During development specific regions on the chromosome enlarge or puff. These puffed regions indicate sites of intense gene activity -- RNA synthesis. Puffs can also be induced by a variety of experimental treatments. Incubating larvae or isolated salivary glands at 37°C results in the formation of six puffs; incubation in pyridoxol (vitamin B_6) induces only one puff and this has been identified at the region II 48-C. A group of compounds, including pyridoxol, pyridoxal, pyridoxamine, and their phosphates, have vitamin B_6 activity. The purpose of this project was to determine whether these related compounds would cause differences in the puffing pattern on the *D. hydei* chromosomes which could be correlated with their structure, and to determine whether the pyridoxine binds to the site of puff formation.

Isolated salivary glands were incubated in a 10^{-2}M solution of Vitamin B_6 or one of its analogs or in Drosophila Ringers alone. The size of the puff was determined by measuring the puff at II 48-C relative to the band at II 47-B which does not puff. Vitamin B_6 and pyridoxamine phosphate induced the formation of one large puff. Pyridoxal 5-phosphate caused the formation of six puffs including a puff at II 48-C; 4-deoxypyridoxine pyridoxal HCl and pyridoxamine did not induce any puffing. Binding of Vitamin B_6 was determined by indirect immunofluorescence. Isolated salivary glands were incubated in successive steps in pyridoxamine phosphate (PMP), mouse monoclonal anti-PMP antibody, and FITC conjugated goat anti-mouse antibody.

#Honorable Mention - Eastman Kodak Company

SIGNIFICANCE OF THE CEPHALIC GANGLIA IN THE TRANSFERENCE OF INTELLIGENCE IN *DUGESIA TIGRINA*

Davis, Tanya L., Willow Glen H.S., San Jose, CA 95125
2753 Cherry Avenue, San Jose, CA 95125

Last year I became interested in planarians and their ability to transfer "knowledge." Biologists theorized that RNA, which is highly concentrated in the head, is responsible. The question that arose in my mind is this: "Even though the cephalic ganglia is merely a bulbous swelling which is a poor excuse for a brain, how does one know that the learning isn't retained by *it* instead of the RNA in the rest of the body?"

Last year my experimentation was to determine whether the brain *possibly* has a role in memory retention-my hypothesis was that it would. My data supported my hypothesis. I was excited with my findings and decided to experiment further-to prove my previous findings and to make an additional step. I trained 10 planarians with light and electrical shock. When the planarians were trained, I removed the brain from 5 trained worms. I then ground up the 10 trained worms and 5 untrained worms and fed them to 15 untrained worms.

This year's results agree with my previous results-they support the RNA theory, but also show that my hypothesis could be correct. However, I just learned that biologists *very recently* found that RNA is more highly concentrated in the *tail region*!!!! This means that my findings, along with this new information, suggest that the 20-25 year old RNA theory may not be correct. To prove my hypothesis and the RNA theory correct or false would be a great step in the knowledge of how memory retention works-thus helping humans.

#RELATIONSHIP OF PURKINJE CELLS TO STRAIN VARIATIONS IN FOLIAL PATTERNS OF MOUSE CEREBELLA

Rooks, Arthur M., St. Andrew's Episcopal School, Jackson, MS 39216
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A study done by Arthur Rooks (1985) revealed that morphological variations in the folial patterns of the PALB/c X C57BL/6J RI strain (CXB) cerebellum were caused by one autosomal, dominant gene. Research done by Zacevic (1976) revealed the differentation of Purkinje cells was suspected to have a direct relationship to a developing cerebellum. Using the inbred strains, BALB/cByJ and C57BL/6J, the purpose of this research is to define hte relationship between Purkinje Cells and the morphological variations in the mouse cerebellum folial patterns. All mice were anesthetized with .5ml of chlorohydrate and perfused intracardially with 10% Formalin. The cerebellum was excised from the cerebellar peduncles, sliced mid-sagittally, dyed in Thionin, and examined under a light microscope. The cerebellum was examined in BALB/cByJ X C57BL/6J P1, F1, F2 hybrids and CXB RI strains (derived from 20 generations of inbreeding BALB/c X BL/6). In each experiment the cerebellum was examined from the embryological stages to full maturity (adult). After examining the the cerebellums of the BALB/c and BL/6 pups, it was discovered that the cerebella were similar until an average day after birth (p-12 - p-13). The researcher then studied and classified each experiment as "BALB/c or BL/6-like" (Rooks, '85). The number of Purkinje Cells were determined by using Karl Herrup's method of counting Purkinje Cells (1983). In each folia, the number of Purkinje Cells was consistent in all 85% of experiments. The results of the experiments and the observation that the Purkinje Cells became appearant on approximately the same day as folial pattern maturation contribute to a conclusion that the folial pattern of the cerebellum is directly related to the number of Purkinje Cell.

#First Award - American Veterinary Medical Association
Second Award - General Motors ISEF

THE EFFECT OF ACETYLSALICILIC ACID IN THE GROWTH AND DEVELOPMENT OF MELANOTIC TUMORS IN *DROSOPHILA MELANOGASTER*

Maldonado, Jeannette, John F. Kennedy H.S., Santa Isabel, PR 00757;
Box 53, Santa Isabel, PR 00757.

Many genetics studies carried out with *Drosophila melanogaster* can be applied to an infinitive number of diploid organisms. Nevertheless the fruit fly continues to be the preferred insect for genetical studies.

In this investigation *Drosophila melanogaster* was used for tumor investigation. A 0.1% solution of acetylsalicilic acid was used to control the development of melanotic tumors in the flies culture. The experiment was carried out at a temperature of 29°C, since at this temperature the melanotic tumors appear most frequently in the ML (ts).

To start the investigation, ten larvas were introduced in each culture flask and observed daily until they became adults or up to the first generation. The same procedure was followed to the fifth generation. During this lapse of time we observed that the color of the tumors became lighter from one generation to another until it dissapeared. Based on these results, it might be possible to generalize that 0.1% acetylsalicilic acid is a possible form of control for the melanotic tumors in the ML (ts).

THE EFFECT OF POLYUNSATURATED AND SATURATED FATS ON THE GROWTH RATE OF POULTRY

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In my past two years of research I found that fats added to poultry feed increased the growth rate. This years research involved a growth and development study of chickens fed two previosisly tested feeds with saturated and polyunsaturated fats added.

There has been much public awareness about saturated fats being harmful to your health. A second purpose of my research was to see the difference in body fat produced by chickens fed with saturated and polyunsaturated additives.

On August 5, 1985, I selected 150 chicks and diveded them into 6 groups. Individual weights were recorded. Each group was fed one of the following: Game Bird Feed, plain (control group); Chick Starter, plain (control group); Chick Starter with polyunsaturated, Chick Starter with saturated, Game Bird with polyunsaturated, Game Bird with saturated. The fats were added at a ratio of 200 ml to 25 lbs of feed.

The conclusion to my research is that saturated fats added the most body weight but upon dissection found this weight to be primarily fat. The hearts were totally encased in fat in each chicken. The death rate was the highest in those groups also.

Polyunsaturated fats had good weight gain, well developed breast, and a low death rate.

Polyunsaturated fats are clearly a better additive for chicken feeds to improve poultry growth. Saturated fats can be used but there are definite health hazards, of which should be considered harmful also to hamans.

#First Award - United States Air Force
Fourth Award - General Motors ISEF

ECOLOGY, LIFE HISTORY AND POPULATION DYNAMICS OF A SMALL MAMMAL POPULATION IN POTTAWATOMIE COUNTY, OKLAHOMA.

Black, Andrew H., Bishop McGuinness H.S., 801 NW 50th, OKC, OK 73118; 4003 Blaine Road, Shawnee, OK 74801

A small mammal population was studied from September, 1984, through February, 1985, and from November, 1985, through February, 1986, in a savanna area in Pottawatomie County, Oklahoma. Five 64 square meter quadrats were subdivided into two meter square areas and Sherman Live Traps set at two meter intervals. *Sigmodon h. hispidus*, *Peromyscus maniculatus*, *Cryptotis parva*, *Neotoma floridana* and *Mus musculus* were collected in the study area. All rodents were toe-clipped for future identification and mark-recapture studies. Ecology, growth rate (g/day), longevity age distribution, sex ratios, population size (Lincoln-Peterson and Schnabel Methods), home range (minimum) and movement patterns (ADBC) are described for rodents in the study area. Data and results in Study 2 were compared to data and results obtained during Study 1. Results of research on these rodents from Oklahoma and other parts of their range in North America were compared to results obtained in this two part study in central Oklahoma.

THE EFFECT OF SODIUM ON THE STAGES OF BLASTEMA DEVELOPMENT (BEFORE AND DURING DIFFERENTIATION) ON THE REGENERATION OF PLANARIA.

Frand, Alison R., Upper Dublin High School, Ft. Washington, PA 19034
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The purpose of this experiment was to test the effects of adding sodium to a solution in which planaria were regenerating on the stages of blastema development (before and during differentiation). Current regenerative studies have centered around discovering the internal stimuli which prompts regeneration. Sodium was chosen as a testing medium because it affects both of the suspected stimuli, bioelectricity and the nervous system.

Five groups of ten worms were dissected. Four of the five groups were allowed to regenerate in different concentrations of sodium while the last group regenerated in springwater as a control. The worms were observed and measured until they began to differentiate. Then, they were observed and measured for another four days. Next, 50 more worms were dissected. Their segments were allowed to regenerate in springwater for 4 days. Then, both the heads and tails were divided into 5 groups of ten. Four groups were allowed to continue regenerating in sodium solutions for four more days, the other group regenerated in springwater for four days. All groups were regularly observed and measured.

It was found that sodium severely impairs both stages of regeneration. Sodium interfered with the functions of nerve cells, disabling them from prompting regeneration. Sodium ions also prevented the establishment of polarity and interfered with bioelectrical currents, resulting in a halt in the regenerative process. Sodium also impaired the process of morphogenisis. It was found that both nerves and bioelectrical activity provide stimuli for regeneration and that both factors are needed for regeneration to occur.

PLANARIA: A SIX-YEAR STUDY

Sullivan, Charlotte C., Hattiesburg H.S.,
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618 Woodland Hills Drive
Hattiesburg, MS 39401

In this science project I studied the effects various amino acids, a magnetic field, vitamins C and E, radiation, and environmental stimuli have on planarian regeneration. I observed the effect different water temperatures have on the time required for planarians to produce cocoons and the time required for planarian cocoons to hatch. I conducted an experiment to discover the effects that three different types of water have on the lifespan of planaria. The results of this project show that those planarians kept in dilute amino acid solutions tend to have an increased rate of regeneration as well as an increase in the total percentage of planarians that regenerate. Planarians kept in a magnetic field regenerate faster than planarians kept under normal condictions. Vitamins C and E increase the rate at which planarians regenerate. Radiation has a detrimental effect upon planarians causing regeneration either not to occur or to be rendered incomplete. Planarians regenerate best when kept in an environment of constant darkness. Warm temperature has no significant bearing on the rate at which planarian cocoons hatch. I found that pond water provides the ideal living environment for planarians.

#A THREE YEAR STUDY ON NEST SITE PREFERENCE AND PATTERNS OF THE EASTERN BLUEBIRD (SIALIA SIALIS)

Harris, Rischelle, Newark H.S., Newark, AR 72562;
Route 5, Box 668C, Batesville, AR 72501.

In October of 1982, ten bluebird boxes of identical construction were placed at ten sites at near equal heights above the ground on fence posts at various distances apart. Data collected over the three year period included arrival time of male scout bluebirds, time nesting began, number of eggs per nest, number of eggs hatched per nest, number of birds fledged, and number of broods per yearly season. Parameters for study were correlated for each nest site. These included direction of front of box, distance to nearest tree, actual height of box above ground, distance to nearest water source, distance to nearest powerline, distance to nearest bushes or shrubs, availability of pasture area, distance to road, distance to nearest man-made structure, and distance to nearest bluebird nesting site. Total number of eggs lain, hatched, and birds fledged were computed for each breeding season. Number of broods and fledged steadily improved from 1983 to 1985, due probably to return of young to nest site where reared. Through correlation of number of broods with each box's individual characteristics, determination was made that the most favorable parameters preferred by nesting bluebirds were closeness to dirt road, closeness to powerlines, between 50 to 100 feet from the nearest tree, and availability of open spaces. Further investigation of additional factors preferred for nesting will be conducted for the spring and summer broods of 1986 and data added to this project to help formulate more accurate and productive conclusions.

#First Award - United States Navy/Office of Naval Research
Fourth Award - General Motors ISEF

THE EFFECT OF CARBONATED REFRESHMENTS ON THE LIVER, PANCREAS, URINE AND BREEDING OF THE DOMESTIC MOUSE

Rivera Rivera, Jorge, Porfirio Cruz García, High School
Bo. Padilla, Corozal P.R. 00643

In this experiment the damage caused by carbonated refreshments in the liver, pancreas, kidney and in the breeding of domestic mice (Mus-musculus) will be determined. As observed, many young adults are consuming a large quantity of carbonated refreshments, substituting it for essential foods, without really realizing how harmful it is. When different doses of carbonated refreshments are administered to the domestic mice (Mus-musculus), it will then affect its liver, pancreas, urine and we can observe congenitial malformations in the mice's breedings.

The mice were distributed 10 to the control group and 20 to the experimental group. Once the different doses of carbonated refreshments were administrated to the mice, changes in their livers were rapidly observed, as demostrated by the increase number of hepatocytes, which indicate that there is a regeneration of its kind. In the pancreas, the islets of Langerhans were extremely enlarged. This means that they are hyperfunctional, and would then secrete a large amount of either insuline or glucagon. If there is a large secretion of insuline, this will promote hypoglycemia. However, if there is a large amount of glucagon secreted, this will promote a hyperglycemia.

Kidney congestion and dilatation of the veins were present. Nephrons with double nucleus were also found, indicating that some kind of damage was present in the tissue. This would imply malfunctioning of kidney and urine secretion.

In their breedings, a series of congenitial malformations were observed, such as: Mus-musculus without backfeet, without a tail, or completely deformed.

ISEF PROJECT CATEGORIES

Note: This preliminary list of Category Descriptions has been made up in order to help students and teachers make category selections.

Behavioral and Social Sciences: Psychology, sociology, anthropology, archaeology, ethology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, reading problems, public opinion surveys, and educational testing, etc.

Biochemistry: Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc.

Botany: Agriculture, agronomy, horticulture, forestry, plant biorhythms, palynology, plant anatomy, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algology, mycology, etc.

Chemistry: Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.

Computer Science: New developments in software or hardware, information systems, computer systems organization, computer methodologies, and data (including structures, encryption, coding and information theory), etc.

Earth and Space Sciences: Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speleology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

Engineering: Civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc. Power transmission and generation, electronics, communications, architecture, bioengineering, lasers, etc.

Environmental Sciences: Pollution (air, water, land), pollution sources and their control, waste disposal, impact studies, environmental alteration (heat, light, irrigation, erosion, etc.), ecology.

Mathematics: Calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics.

Medicine and Health: Medicine, dentistry, pharmacology, veterinary medicine, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, optometry, etc.

Microbiology: Bacteriology, virology, protozoology, fungal and bacterial genetics, yeast, etc.

Physics: Solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

Zoology: Animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, anatomy, paleontology, cellular physiology, animal biorhythms, animal husbandry, cytology, histology, animal physiology, neurophysiology, invertebrate biology, etc.

CATEGORY INTERPRETATIONS

Below are project areas about which questions frequently arise. It is included only to provide some basis for interpretation of the category descriptions.

Instruments: The design and construction of a telescope, bubble chamber, laser, or other instrument would be Engineering if the design and construction were the primary purpose of the project. If a telescope were constructed, data gathered using the telescope, and an analysis presented, the project would be placed in Earth and Space Sciences.

Marine Biology: Behavioral and Social Sciences (schooling of fish), Botany (marine algae), Zoology (sea urchins), or Environmental Sciences (plant and animal life of sea, river, pond).

Fossils: Botany (prehistoric plants), Chemistry (chemical composition of fossil shells), Earth and Space Sciences (geological ages), and Zoology (prehistoric animals).

Rockets: Chemistry (rocket fuels), Earth and Space Sciences (use of a rocket as a vehicle for meteorological instruments), Engineering (design of a rocket), or Physics (computing rocket trajectories). A project on the effects of rocket acceleration on mice would go in Medicine and Health.

Genetics: Biochemistry (studies of DNA), Botany (hybridization), Microbiology (genetics of bacteria), or Zoology (fruit flies).

Vitamins: Biochemistry (how the body deals with vitamins), Chemistry (analysis), and Medicine and Health (effects of vitamin deficiencies).

Crystallography: Chemistry (crystal composition), Mathematics (symmetry), and Physics (lattice structure).

Speech and Hearing: Behavioral and Social Sciences (reading problems), Engineering (hearing aids), Medicine and Health (speech defects), Physics (sound), Zoology (structure of the ear).

Radioactivity: Biochemistry, Botany, Medicine and Health, and Zoology could all involve the use of tracers. Earth and Space Sciences or Physics could involve the measurement of radioactivity. Engineering could involve design and construction of detection instruments.

Space-related projects: Note that many projects involving "space" do not go into Earth and Space Sciences. Botany (effects of zero G on plants), Medicine and Health (effects of G on human beings), Engineering (development of closed environmental system for space capsule).

Computers: If a computer is used as an instrument, the project should be considered for assignment to the area of basic science on which the project focuses. As examples: if the computer is used to calculate rocket trajectories then it would be assigned to Physics, or if the computer is used to calculate estimates of heat generated from a specified inorganic chemical reaction then it should be entered in Chemistry, or if the computer is used as a teaching aid then it should be entered in Behavioral and Social Sciences.

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